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MAN AND THE MACHINE

MAN AND THE MACHINE

EDITED BY
HUBERT WILLIAMS

PREFACE BY
J. B. PRIESTLEY



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PREFACE

IT does not seem to me that I have any right to stand, even for a moment, between any intelligent reader and these important and extremely valuable chapters. I have not given the main problem the consideration it deserves. I cannot be considered an authority on any of the minor questions raised by the main problem. Most of the contributors to this volume are experts, of one kind and another, and I am no expert, except perhaps in certain branches of my own craft of writing. The only excuse for my presence here is that I have been brought in merely as a witness to the deep significance of the theme, that of the relation between Man and his machines. I am here—as the editor has told me—to “appreciate the problem”. It was forced upon my attention when I was writing *English Journey*, for as readers of that book will remember I found my way into several large modern factories and then could not help asking myself certain questions concerning men and machines. Some of those questions are answered in the chapters that follow. But the chief purpose of this book, I take it, is to bring the reader close to the problem—or rather to the whole nest of problems. And a terrifying brood they are too.

We must begin, I think, by letting in a little

daylight. Thus, there is nothing mystical about machines. Those people who write stories and plays showing persons worshipping giant dynamos, who insist upon using bits of machinery as motives for decoration, all seem to me to make the mistake of supposing that there is something mystical about a machine, so long as it is large and complicated enough. The fact that it has to be imposing before it takes on this mystical quality gives these people away, for if the big machine has it, then the little machine has it too ; and if the giant dynamo, then why not the tiny cigarette-rolling machine or the automatic razor-blade stropper ? It seems to me that the machine, no matter how big and complicated it may be, is only a tool. Nor is it something new to this world. There have been machines for thousands of years now. Only of late we have immensely enlarged and complicated them. But their fundamental nature remains the same. They are tools, not gods or monsters.

The machine as such is no more a menace than a saw or a hammer. We can see that at once if we simplify the matter. If fifty of us were wrecked on a remote island, decided to build huts and make furniture for them, and found ourselves miserably hacking away with blunt tools at stubborn timber, we should hail with admiration and delight the ingenious fellow who contrived for us there an equivalent of a circular saw. Seeing his machine—for such it would be—in fruitful motion, it would not occur to us, freed from our hacking, that the serpent

had been now introduced into our Eden. We should see the machine for what it truly is, a wonderfully powerful, convenient tool, a hundred saws in one, a time and labour saver. I have no doubt whatever that it has been the inventors, determined to increase the resources of our race, and not the machine-wreckers, blinded by prejudice and petty interest, who have contributed to the Good Life. Murders have been committed with the aid of hammers, but nobody thinks of the hammer as anything but an indispensable unit of the tool-box. In the same way, all sensible persons see the machine as a powerful but innocent ally, so many long untiring legs and arms added to us, and not as the sinister creator of social and economic injustice. Such injustice is our affair. We must remedy it. That the rapid development of the machine in our time has given the matter a horrible urgency, I do not deny. Half the troubles of our time are caused by the fact that our inventors and engineers are years ahead of our economists and politicians. Man the machine-maker has far outdistanced Man the organizer. It is monstrous that an inventor, bringing into the world some wonderfully ingenious time- and labour-saving machine, can actually do more harm than good. Obviously it is not the machine that is at fault. It is the economic system that is lagging years behind. If a gigantic excavator can do the work of several hundred men, and promptly puts those men out of work, then those men cannot be treated as if they were idle fellows not disposed to earn their

living. The introduction of large-scale machinery everywhere seems to me to call for a planned economy, and probably the socializing of all major industries.

This does not end the problem. There is another problem behind it, perhaps the more important. For even when we have a planned economy, and with it some nearer approach to social justice than the world has known before, we have still to decide which is the more important, Work or Leisure. In other words, is it better that people should work at mechanical tasks, for the shortest possible time and the biggest possible reward, perhaps doing their four-hour shifts in gigantic state factories, or is it better that we should use machinery not so much to produce goods quickly and cheaply but to furnish men—potential craftsmen—with labour- and time-saving power? For we must remember that the happiest of men are not those who have plenty of leisure but those who toil away, for hours that no Trades Union would permit, at work that satisfies and expresses them. I think it may be possible to compromise between these two systems, just as I believe it possible to compromise between chaotic capitalism and rigid communism, by socializing all the more important industries, those involving the necessities of life, and leaving the rest, the luxuries, to private enterprise. (A private ownership of the country's water supply, for example, is unthinkable. But equally unthinkable is a State Millinery Department.) So far, we have thought too much about the

machine as an aid to large-scale production, and too little about it as the ally of small-scale production, of craftsmanship, work with an individual flavour. This was inevitable with steam power, but now we have electricity, which is power that can be laid on like gas and water, it is time we remembered that Man is a craftsman as well as a manufacturer.

One last point. Most of us who are given to expressing ourselves in print or on platforms are anything but machine-minded. We are apt to be repelled rather than fascinated by the sight of the wheels going round. We can approve of the machine in theory, but not in actuality. Therefore we forget that to a great many men (rarely women, I fancy) the machine has offered an opportunity of self-expression hitherto denied them. For them this is the Golden Age. We do not hear much about their delight in the machine, though we see evidence enough of it, simply because the machine-minded are not as a rule very good at expressing themselves in words. (And how they jump at Kipling, their laureate !) But there is no doubt whatever that such persons find a deep æsthetic pleasure in the machine, and even those of us who are not machine-minded are beginning to see a certain beauty in mechanism that functions perfectly. It is probably too early to discover whether this machine-mindedness is good in itself, whether it is the friend or the enemy of the Good Life. But we should recognize that it exists, that it is indeed a very potent force in our world, and that we must not be in a

hurry to condemn a form of expression that we do not happen to enjoy ourselves.

' There are far too many books published nowadays. A litter of useless books is a nuisance. But here for once is a book that means something and deserves a very large audience. I hope that audience will include the machine-minded as well as the rest of us. And now I will let the experts address you.

J. B. PRIESTLEY.

INTRODUCTION

By HUBERT WILLIAMS

THE proper relationship of men to the machine that they have unwittingly created is a problem that intimately concerns everybody now living. Are men to control the machine, or be controlled by it? Are they to use it for some seen and generally acceptable purpose, or are they to become the passive victims of unintelligent mass production? This is about the time when they must make up their minds. Upon the wise solution of this question of Who Is To Be Master the whole future course of what we call civilization quite obviously depends.

It is, of course, not in the least difficult to decide what ought to be the correct answer. If the whole vast structure of modern mechanized industry has any meaning at all, its purpose must be to serve mankind. And mankind doesn't mean a mere regiment of the elect, but all men now living. That, then, is the answer. The machine must be the slave of man, employing its vast resources and perhaps still vaster potentialities in the task of making life easier and richer for everybody.

There is no difficulty in seeing *that*. The difficulty begins when we try to puzzle out how

it is to be done. Some people think that the machine is already doing its job pretty successfully ; other people say quite uncompromisingly that mechanized industry has made a mess of things. The truth perhaps is that the problem is so intricate and many-sided that nobody yet comprehends the whole of it. Nobody can yet focus it in its stupendous totality. For any progress to be made, it has got to be pulled to pieces, and its component parts laid bare for close inspection and subsequent decision as to their value and desirability. Then and only then it will be possible to arrive at general agreement as to whether cheap motor-cars are in the main a blessing or a pest, or whether chain shops like Woolworth's are a boon to consumers or a deadly drug sapping the virtue of the public taste. At present, no sort of agreement could be found on these or similar manifestations of highly mechanized industry.

The simple aim of this book is to cast a certain amount of light—a sort of preliminary light, if that can be said to mean anything—on certain aspects of the machine and its impact on ordinary men and women. First of all, what is meant by the machine ? For our purpose it stands for the rapidly changing industrial conditions and methods of the post-war period, during which time advance in both manufacturing and distributing processes has been so rapid as to be bewildering both to those with lifelong experience of industry as well as to those whose lives and habits of thought might lead a casual observer to suppose that they were not living in an industrial country. It is to

this latter class that so many of our political, cultural and religious leaders have perhaps unfortunately been drawn. This fact has not tended towards a better understanding of an extremely difficult situation.

Certain things are definitely known to have arisen from recent changes in industrial methods. There has been a great deal of dislocation of employment ; individual craftsmanship is far less valued than ever before ; and a possibly rather spurious attractiveness in the manufactured product is now more important than any quality of durability. Whether this last result is good or bad it is perhaps not yet possible to be sure, but that the first two have meant a very great volume of human suffering scarcely a sane person will be found to deny. If there is any reason for civilization it surely is to lessen human suffering. In that respect, therefore, a good deal must be written down on the debit side. But there is another side. The difficulty of arriving at any sort of working balance is that each man or woman on whom the machine bears in some way or other is only really and usefully able to relate how it has affected him and his associates.

In this present book, eleven writers, all of whom are or have been connected with some or other aspect of industry, contribute their personal point of view as to the good and evil of modern mechanization. Some also attempt to show how certain results of mechanization which are not in themselves either good or evil, such as increased leisure, may be employed for what is thought to

be either the spiritual, physical or material advantage of men and women. Each one of the contributors is, of course, bound by the circumstances of his upbringing, his vocation and accumulated experience. And these personal factors are almost as varied as it was possible to make them. The monster that (according to some) threatens to engulf us is thus regarded from a number of widely different angles. For instance, the point of view of Sir Harold Bowden, who is amongst other things a bicycle manufacturer, is in hardly any respect the same as that of Mr. Alfred Varley, who is a checkweighman at a colliery. And that goes for most of the other contributors. But does truth then lie anywhere? Well, it is perhaps a synthesis of the opinions and experience of many different men. If that be so, then some fairly useful sort of impression of the real significance of the "monster" ought to be gathered from these contributions. No more than an impression, however. To suggest more would be presumptuous.

It will be useful to divide those who are affected by the machine into two main categories. These are :

Those Who Employ The Machine ;
and
Those Whom The Machine Employs.

It will then be found that the views of nearly all employers of labour (with the possible exception of certain individuals whose businesses have happened to suffer from mechanization) are inclined

to run very much on all fours. The same may be said for the views of the wage-earners, and those unfortunate men who are no longer wage-earners, due, as every single one of them is positively sure, to the malignity of the machine. Now the significant, unfortunate but possibly inevitable thing is that the employer and the employed will be found to be in serious disagreement. I have said that that is possibly inevitable. It may or may not be so under the existing order of society. But this much is certain. So long as this disagreement continues, there is no chance of unity of outlook between the employer and the wage-earner, or of any acceptance of common interests. Without that unity neither real progress nor industrial peace are practicable hopes. The machine, therefore, must not only benefit all—as all employers and most economists hold that in the long run it does—but to all those most intimately concerned must quite plainly appear to benefit all.

There is, of course, a third class of men and women who are neither employers nor wage-earners, but who, by virtue of their training, vocations and experience, may be expected to have a worth-while opinion on this extremely vexed problem. Several of them have contributed to this book. They have been perhaps somewhat arbitrarily grouped under the heading of Observers. It will be seen that the opinion of these contributors, except in one instance, approach nearer to those of the employers than to those of the employed. Without jumping too hastily to conclusions that cannot yet be proved, a quite

good enough reason for the measure of agreement that does undoubtedly exist between Observers and Employers may be found in the fact that the upbringing, activities and material circumstances of the two groups are more or less similar. The only one of the Observers who has affiliations with Those Whom The Machine Controls is Mr. Sherwood, and his view of the machine will be seen to agree in the main with those of the wage-earners.

Then, finally, there is the very important fact that whilst the great majority of us are producers of goods or services, every single one of us is a consumer. Apart altogether from the way in which mechanization has affected any of us as the one, how has it affected all of us as the other? It is only fair to the animal that its virtues as well as its vices should be listed. Thus it can at once be said that from the consumers' point of view mechanization has brought more good than evil. There is evidence a-plenty in our daily lives. Many of the amenities that we all enjoy were unknown to our forefathers; of the rest only the favoured few knew them as part of their ordinary experience. Only the rich knew the pleasurable sensation of silk stockings; now near-silk is the birthright of the multitude. The whole texture of life as we know it—at least the surface texture—is the product of mechanized industry. To mass production we owe our clothes, our transportation, much of our amusement and culture, and a good deal of our food.

Greatly as our lives are affected, however, by

these apparently incontrovertible signs of a beneficent machine, it seems plain, if certain of the contributors to this book are to be believed, that the shower of material gifts, which is undeniably due to the working of the machine, has not added to the sum of human happiness.

I have said, "If these contributors are to be believed." The contributors in question are all wage-earners, and they are all in the main agreed. They are of different ages, different trades, and come from different parts of England. They may, of course, be wrong in their estimate of what the machine has done for civilization, but it is at least probable that they represent in their opinions what millions of their fellow-wage-earners *think* that the machine has done to them. And their general opinion is, apart from any material changes and attendant hardships that it has brought, that it has taken the salt from their lives.

Cheap clothes, cheap car-rides and continuous broadcast, agreeable as these may be, aren't really enough for any man. He wants to feel that he is expressing himself. All educated middle- and upper-class people recognize this feeling, and know that without this opportunity for self-expression, in whatever form it may take, their lives simply would not be worth the living. It is one of more unfortunate results of the government of this country by the middle and upper classes that the need of *everybody* to lead a full and interesting life is not recognized by those in positions of influence and power. It is too often assumed by what may still be called the "govern-

ing class " that that vast and largely unexplored tribe known as wage-earners wants nothing beyond food, shelter, the bare rudiments of education, and where possible a little extra money for drinks and occasional trips to the sea. That blindness and carelessness on the part of the political and industrial leaders of this country (to look no further) has driven the bulk of wage-earners into a deeply felt if somewhat uncomprehending hostility to the machine. They look upon it as a malign force that is progressively robbing them of any chance of being interested in their work, which is still so large a part of their lives. If that is so, and it is certain that many people think that it is, it constitutes a terrible indictment against the machine and those who honestly imagine that they are controlling the machine. It is a just and sufficient reason for the often-lamented antagonism of the classes. If it be true, it must cause more unhappiness than a good-sized war. It must wreck more lives than the most dreadful catastrophe of nature, such as a flood in China or an earthquake in Kashmir.

But it may not be true. That can only be decided by a full-dress investigation into the lives of those who are closely involved with the machine in its many aspects. Since without further inquiry little more can definitely be known, and the hostility and unhappiness of which I have spoken must continue, it certainly seems desirable that some such investigation should be undertaken.

PART I

THOSE WHO CONTROL
THE MACHINE

THE FUTURE OF LEISURE

By SIR HAROLD BOWDEN, Bt., G.B.E.

(Chairman of the Raleigh Cycle Co., Vice-President of the Federation of British Industries, lately Chairman of the Council of the British Olympic Association)

I

WHEN a few years ago at a dinner of the British Olympic Association I suggested, only half-seriously, that we should soon require a Minister of Leisure, the idea struck the Press as so novel or fantastic that it appeared in streamer headlines in newspapers all over the country. To-day one can hardly open one's daily paper without reading something about the need for education for leisure or of some kind of organization to tackle the problem of leisure-time occupation.

There is no doubt that the Machine Age has brought about an economic dilemma which has no parallel in history. Through all the centuries man has toiled to wrest from nature the wherewithal to live. Now science has entered in and given him a magic wand with which he can produce wealth without corresponding toil. That is, if you like, an over-statement, but it is a fact that less and less labour is needed to produce all that

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man needs, and that in terms of practical realities 10,000,000 workers can even to-day produce enough to enable 40,000,000 to live. It seems to me that this changed and still changing condition has created an economic problem entirely new in character. The problem, put briefly, is to find a pretext other than labour for distributing purchasing power. I am going to suggest that we shall have to recognize paid leisure as well as paid labour.

~

II

Since man became a social animal, it has always been assumed that work or the products of work were the sole or main pretexts of purchasing power. He exchanged either his labour or the products of labour for money (or its equivalent) with which he could purchase for himself and his dependants the things they required. "If any should not work, neither should he eat." On this basis our modern monetary system for the exchange of goods and services was evolved out of the barter system. Purchasing power is put into circulation in exchange for work or the products of work. We give money in exchange for services or goods, and this money proceeds to circulate so as to effect the interchange of services and goods. In recent centuries there has been added, on philanthropic grounds rather than economic, another pretext for the issue of purchasing power. A certain proportion of the people who for reasons of age or health have nothing to "sell" receive purchasing power from the community

in the shape of pensions, benefits, etc. This system has spread very rapidly in recent generations, and there is no doubt that as machinery tends more and more to displace human labour we shall find it necessary to revise the tacit assumption that only the labourer is worthy of his hire.

At the present time some 2,000,000 persons are receiving payment not for work that they do but for their assumed willingness to do work that, owing to various causes over which they have no control, is not required of them. These persons are living a life of enforced leisure partly, in my view, owing largely to the substitution of machine-power for man-power. It is only fair to say here that some economists do not admit that machines supplant men, except temporarily. They maintain that machine-production by lowering prices increases demand and that, demand being unlimited, those who have been displaced inevitably return to industry. The power of the machine to produce must, however, in my view, outstrip the power of man to consume, and as time goes on the number of man-hours required to satisfy men's needs will progressively diminish. It is not fantastic, for instance, to suggest that before many years are past the machine will make it possible for all the work of the nation to be performed by half the present working population working, say, six hours a day.

If this is anything like the truth, then either the whole working population will be unemployed most of the time, or large numbers will be per-

petually unemployed. In either case the problem to which I have referred will present itself. Some means, different from those now prevalent, must be designed to place adequate purchasing power in the hands of the whole population, including both the meagrely employed and the wholly unemployed. That is one side of the problem. The other is to occupy the empty lives of a community whose physical or mental toil is no longer a saleable asset. The two problems are ultimately perhaps one. It is at any rate certain that leisure, whether voluntary or enforced, cannot be fittingly used without something more than a living pittance. It is easy for theorists to supply the solution of the purchasing power problem by endowing the State with a bottomless purse. No solution that has yet been propounded, however, has, so far as I know, faced up to the fact that the monetary systems of the world's interlocked civilizations are founded on credit. This fact alone makes it impossible to contemplate any violent reform of a system which, however far it may fall short of the ideal, has brought to the bulk of our population a higher permanent standard of living than has been reached by any country in the history of the world. We have seen too recently the effects upon national life of unbalanced budgets and unrestrained inflation to have any faith in monetary experiments which are not embarked upon in a spirit of the utmost caution. As an industrialist I have seen at close quarters the effect of improvident State expenditure upon the lives of the wage-earning classes. Though I

have long been aware of a flaw in the present mechanism of distribution,¹ and though I believe that the policy of the Treasury and Bank of England, who between them appear to control our monetary system, errs on the side of excessive conservatism, I should be the last to advocate a rash adoption of any untried theory. This is eventually a problem that must be solved by a gradual transition from the orthodoxy that has served us well in the past to a new orthodoxy better suited to the changed circumstances of to-day and to-morrow.

III

So much for the monetary side of the picture. In what I have to say on the Future of Leisure it will be necessary to assume that by some means or other we shall evolve a system that will secure a reasonable livelihood for the working classes whether industry can find sufficient work for them or not. The other side of the picture shows a community endowed with an indefinite amount of time which it can fill as it pleases.

The problem of Leisure has come upon us already and found us unprepared for it. The

¹ In a letter published in *The Times* on 27th October, 1932, I wrote : " We have entered upon an era of new conditions that the old economists never foresaw, and it is necessary to think in terms of these new conditions. Not unemployment, nor even the restoration of trade, but the distribution of purchasing power is the kernel of the problem. The products are there waiting to be exchanged for one another. If we can discover how to consume this idle wealth, there will be no problem of idle workers."

five-and-a-half-day week created one problem of leisure which was partly met by the modern equivalent of the Roman circus—football and cricket amphitheatres. There are literally millions to-day whose leisure is devoted almost wholly to talk that turns around the merits of a football team, enlivened by weekly visits to the scenes of their heroes' deeds. That is an interest which is undoubtedly superior to the aimless street-corner or public-house loafing of previous generations; but it is reasonable to entertain the hope that, as time goes on, the masses will have opportunities of developing interests more satisfying to themselves and perhaps more valuable to the community.

If we do not feel altogether at our ease about the present spare-time occupation of young working-men who watch or talk about games which, were the facilities available, they should be playing themselves, what are we to think of those poor unfortunates whose life, week in week out, for months or even years, is given over to enforced idleness? Almost the worst feature of such a condition of things—even worse, perhaps, in many cases than the poverty which is at any rate mitigated by relief measures—is the demoralization and state of hopelessness caused by sheer idleness. This fact has been belatedly recognized, and in the past two or three years much good work has been done by the Personal Service League and similar organizations to provide decent occupation for men deprived of wage-earning work. But the trouble goes too deep to be removed by temporary

palliatives. If one-sixth of our "working" population is to-day perpetually unemployed and if, as is probable in the not distant future, the whole of our "working" population will be in a constant condition of part-time employment, that is, working probably a 36- or even 24-hour week, leisure assumes a totally new significance in the scheme of things.

It becomes a question not of what the people will do with their off-time, but what they will do with their lives. A century ago the lot of the working-man was to sleep, eat and work—he had no time for anything else. This century he has already left that state of things far behind and, as I believe, will soon be faced with the question of how to use the abundant new liberty that the coming of the machine and the reorganization of industry has placed at his disposal. The value of liberty lies not merely in being free from compulsion. Its chief virtue for the individual is the freedom it gives him to do something worth doing.

IV

If by leisure we mean the opportunity to do the things we want to do, then it would seem that the community has two obligations to fulfil. It must, in the first place, not leave the individual without guidance as to the things he wants to do. The function of education is to give every individual a start on the way to developing and expressing his individuality. And, in the second place, when he is no longer in leading-strings he must have

the external facilities for getting the best out of his life. To say that the community has these obligations is not, necessarily, to say that the State must be responsible. Already, there are many examples of both the guidance and the facilities being made available within the ranks of industry, and it is highly probable that the way of future development will be found along the lines traced out by those firms which recognize that their duty to their work-people is not limited to the payment of a money-wage. Whether progress is evolved from within industry or from without, it is clear that we must envisage a future in which we must plan for the leisure of the masses.

A mere recital of a few of the uses to which spare time may be, and is, put will indicate the necessity for giving thought to the matter in an age when the masses of the population are no longer occupied from waking to sleeping with the tasks for which they are paid. There are, broadly speaking, three main categories into which leisure-time activities may be divided—active, creative, and passive. Some are on the border-line, some fall into two categories, all are equally legitimate in that they will be the expression of the individual's personality. If we feel that some forms are preferable to others, it will at once be obvious that more planning, more preparation, in short, more education is required for the worthier types. Consider a few of the things with which people do actually occupy themselves in their spare time :—

Passive.		Active.	Creative.
	<i>Physical.</i>	<i>Intellectual.</i>	
Doing nothing	Playing games	Reading	Arts
Talking	Physical exercises	Music	Crafts
Gambling	Athletics	Attending lectures, classes, etc.	Carpentry
Attending games, cinema, other entertainments, political meetings, etc. etc.	Walking	Nature-study	Mechanics
	Cycling	Sight-seeing	Needlework, etc.
	Soldiering	Acting	Gardening
Reading			Small farming
Listening-in			

It is obvious, from the most cursory examination of these leisure-time subjects, that some of them require no effort or concentration, while others demand a capacity for taking pains to overcome difficulties, or in other words, the will to acquire knowledge or ability which in the view of the learner is worth acquiring. The passive occupations mentioned in the first column do not necessarily make any such demands, and those mentioned in the second column demand physical effort only. The others imply the existence in the individual of an urge to take the trouble to improve himself intellectually. Most of us are born lazy and such a desire is not as a rule natural to the human animal. It is acquired by education, and it is not too much to say that the main aim of education should be to circulate the desire to attain knowledge or ability for the sake of the pleasure and power that it brings. What particular branch of knowledge is to be pursued must depend upon the individual bent. There are to-day extensive facilities at the disposal of all—the night schools, day continuation schools, technical schools, the Workers' Educational Associa-

tion, broadcast talks, the free libraries, and museums and other organizations offer abundant opportunities for self-development of which a growing number take advantage. On the other hand the demand for playing fields far outstrips the supply, and so long as the masses of the people are herded together in large towns it is almost inevitable that this should be so.

v

It is not in the least my intention to decry the passive occupations merely because they are not energetic or creative. Most people will feel that when the hours of labour are over they both need and have earned the right to relax, whether their relaxation takes the form of doing nothing at all, exchanging conversation, reading for amusement, playing cards or other indoor games, gambling, or allowing themselves to be entertained. It is only when such occupations are pursued to excess and to the exclusion of any other interest that they become undesirable or actually harmful. Gossip at the village pump or in the village inn is one of the foundations of our social life, but standing at the corner of the street, which for long has been the main occupation of thousands in the depressed areas, is a form of existence for which it is essential that we should devise alternatives.

The places where men and women forgather for the purpose of doing nothing have not only multiplied but changed out of all recognition during the last few generations. The public-house or inn of the present day is a clean, airy, orderly

place compared with fifty years ago. Nor is it any longer the only place where refreshments, amusements, and social contacts may be obtained. The rise of the club, the tea shop and restaurant, which provide surroundings usually far superior to people's own homes, has greatly improved the opportunities for filling in spare time.

Popular education introduced only two or three generations ago has enabled the whole population to read. It has not necessarily taught them what to read. Possibly the most popular literature to-day consists of the betting columns of the popular Press, which, as circulations have increased, has tended to present its reading matter in more and more easily palatable form. On the whole, however, in spite of the necessity, in the interests of advertising circulation, of giving the largest possible public the reading pabulum which they are supposed to want, it is probable that on balance the popular Press does more good than harm. This is too large a question to be discussed in a paragraph. It was necessary to make a reference to it in order to explain why I have included reading both as a passive (or frivolous) occupation and as an active (or intellectual) one.

The greatest of all means of relaxation to-day is perhaps the cinema. The enormous development of this form of entertainment undoubtedly has its drawbacks, because it lays large masses of people open to various abuses. But millions now spend their evenings in pleasant and healthy halls instead of sitting in unhygienic houses or drinking in saloons. The growing demand for better and

more interesting programmes has already led to a substantial advance in the provision of news reels, and the kind of picture which, without being educative or "uplifting", is based on the realities of life rather than on mere sensation or sex appeal. It is noticeable—though the caterers for public taste have not yet apparently remarked the fact—that good travel or nature pictures invariably attract spontaneous applause, which is otherwise rarely heard in the cinema.

Broadcasting has also become a major factor in the leisure of our people. It combines in a unique manner the "passive" with the "active" use of spare time. Physically, no more inactive situation could be devised than that of sitting in an arm-chair and listening to unseen performers. Yet the wireless programmes have brought much more than entertainment into the homes of the people. They have inspired new tastes, new interests, and a wider outlook. Millions of listeners have been brought into touch with men and affairs and ideas which would formerly have remained far outside their province. There is no reason to assume that its technical development will halt at the present stage. It is not difficult to foresee a time when receiving sets will be so cheap that they will become ubiquitous, and when television will be part of the everyday programme. I do not, however, anticipate that the advent of the broadcast picture will have any marked effect upon the lives of the people except, possibly, to provide them with a counter-attraction to the cinema.

Unfortunately, games and sports must at

present be counted largely among the "passive" recreations, because vastly more people are game-watchers than game-players. Comparatively few fortunate young men and women exercise their bodies. But games-watching, nevertheless, gives not only an interest but also an outlet for that partisanship which is an instinct of social man, and the value of this outlet may be gauged by the far less pacific forms which it takes in certain other countries. At the same time, the natural reaction of healthy young men seeing a playing field is a desire to play; and it would be very much better for them as well as for the nation if they had an opportunity to play. While our big cities and towns continue to expand rapidly across the open spaces at their fringes, there will probably be a deplorable shortage of playing fields for some time to come. But there is hope in the modern tendency to build upwards instead of spreading outwards. One may also expect the factories of the future to choose their sites at some distance from urban centres, allowing for both houses and recreation grounds for their workers in the vicinity of the works.

In any case, it should be one of the guiding principles of national housing policy to provide accessible open spaces for all who want to play. In the meantime, there are various ways in which a general increase of game-players can be brought about. The National Playing Fields Association, for example, has acquired many hundreds of acres of land and turned them into sports grounds. In the future this work will have to be supported

and supplemented by the local and central authorities. At the same time many business firms have realized the advantage of providing well-equipped sports grounds, and in some cases of paying the cost of staffing and maintaining them. Often these grounds, which are used mainly at weekends, are being opened to schools and clubs during the week.

But there will perhaps always be a shortage of fields for games which require a large acreage of space, such as football and cricket. Lawn tennis, which requires both less space and less time, has made rapid progress since the introduction of "Summer Time," and many of the public parks in our towns and cities have been supplied with tennis courts, which are in great demand during the summer months. The greatest hope for the future of popular sport, however, seems to lie in the spread of "natural" games and sports, such as swimming, wrestling, running, jumping, boxing, gymnastics, fencing, throwing the discus, the javelin, and the hammer. All these sports have the advantage of not needing large or expensively prepared grounds, and the Olympic Games show how much enthusiasm they can raise. I look forward to the day when every county and every district will have its organization for miniature Olympic Games meetings, but first we need an abundant supply of trained teachers. That is one of the most effective methods of organizing for leisure at a reasonable cost.

Meanwhile, the twin recreations of walking and cycling—hiking and biking—have in the past few

years attained a popularity they have never reached before. It is estimated that there are no fewer than 10,000,000 cyclists in the country to-day, and with bicycles as cheap as they are there is no reason why this form of recreation should not become universal.

Last on my brief list of active physical spare-time occupations I have put soldiering. I am thinking, of course, of the Territorial Army which, to my mind, offers one of the most attractive of all methods of organizing spare time. There are still those in this country who feel that it is no unworthy thing to equip oneself to defend one's hearth and home in case of attack, and the discipline, special knowledge, healthy exercise and comradeship which Territorial service offers, in addition to the annual holiday under canvas, supply a leisure-time occupation that makes for better manhood and better citizenship as well as physical fitness and efficiency.

I have passed in brief review the types of spare-time occupation which already enjoy and must always enjoy the widest popularity with the majority of people. There is obviously a broad line of demarcation between the passive recreations and the creative. The former are pursued in accordance with natural inclination; the latter demand conscious preparation. Between these two extremes lie a wide range of activities which may depend upon innate tendencies or may be prompted by external encouragement. Some are born cricketers or nature-lovers or painters, others with the right sort of encouragement and oppor-

tunities can be brought to enjoy and excel at gymnastics or amateur acting or carpentry. In both cases self-imposed effort is required to attain the greater skill that gives the greater satisfaction. It would be superfluous to discuss in detail the intellectual and creative occupations. They differ mainly in the quality of satisfaction they yield to those who follow them. What is clear is that the urge to pursue them, where it is not inborn, can come only as the result of general education or specific propaganda and that in most cases special instruction will be necessary to produce the technical ability that is required.

It would appear, therefore, that whereas it may be correct to speak of the organization of leisure in regard to those forms of it which involve teamwork or social entertainment, the term can be used only loosely when it comes to more individual pursuits. The problem here may perhaps be summed up in the statement that comparatively few persons are able to rely on their own resources to amuse themselves. Indeed, according to a recent writer :¹ "Certain inquiries have found cases of able-bodied men who have been reduced to staying in bed all day because they did not know what to do." It is a melancholy reflection upon our civilization that there exist among us persons who have no interest in life beyond the struggle for existence, and the problem we have

¹ For much of the information contained in this section I am indebted to an article on "Workers' Spare Time", by G. Mequet, in *The International Labour Review*, November, 1934.

to solve, now that the machine is making us less and less dependent on human labour, is how to provide the individual with interests outside "work". If, or to the extent that, it is true that hitherto our national education system has in practice succeeded only in teaching people how to exist, that is to exchange their labour for the means of existence, we must revise our aims so as to teach them something of the art of living.

Italy began immediately after the war to appreciate the importance of directing the utilization of the workers' spare time and set up a body "to promote, form, and co-ordinate institutions capable of raising the physical and moral standard of manual and intellectual workers during their hours of leisure". This organization, known as "Opera Nazionale Depolavoro", had about 300,000 members in 1926 and now has more than 2,000,000. A central organization with local branches everywhere, it has given a great impetus to games and sports and has stimulated travel and sight-seeing by reducing fares and conducting tours. One section organizes travelling theatre companies, another devotes itself to the libraries, broadcasting, and the cinema. The influence of the movement is nation-wide and is sustained by political impulse.

Even more diversified is the work of the Higher Council for Popular Education, in Belgium, which is attached to the Ministry of Arts and Science, and operates through provincial Spare Time Committees. They classify their activities into the following sections: (1) Housing, furniture,

and decoration ; (2) gardens and allotments ; (3) small stock raising ; (4) education in relation to spare time ; (5) physical education ; (6) artistic education ; (7) intellectual and moral education. One effect of the work of the Committees has been a significant growth of the system of libraries, and especially travelling libraries in the province of Liège, while the gardens and allotments section and the gymnastic federations have developed in a striking manner under the protective guidance of the Higher Council.

In many other countries, too, there exist national or centralized organizations which direct, stimulate, and co-ordinate the activities of institutions or committees devoted to the utilization of leisure. When at Los Angeles, in 1932, I addressed the International Recreation Congress on "The Use and Abuse of Leisure", I emphasized my conviction that what a man does with his leisure is nobody's business but his own. The time for organization of leisure should cease with our schooldays. If, as I believe is inevitable, we are to have some such central body as Italy's "Depolavoro" or Belgium's "Higher Council", its function must not be to organize leisure but to organize *for* leisure, through local Spare Time Committees and industrial organizations. It must not shepherd the individual into gymnasia, physical drill classes, or educative cinemas. Its activities must be devoted to education and encouragement on the one hand and the provision of facilities and opportunities on the other. To treat leisure-time occupation as compulsory would be to destroy

entirely its value in developing character and expanding individuality. On the other hand, however, I see no harm but positive good in devising a system of education-for-leisure. And so far, at any rate, as young men and women under twenty-one are concerned, attendance at leisure classes or occupation centres might be an essential condition of the receipt of benefits from the Unemployment Assistance Board.

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I began by suggesting that we must cultivate a frame of mind which regards the payment of leisure not as a philanthropic device but as a factor of our economic system. If the 2,000,000 persons at present condemned to inactivity did not exist, we should be an ideally prosperous country. But if, by some miracle, they could be brought into productive employment, the total amount of wages available and of man-hours needed to meet all demands would remain substantially the same as at present. Roughly speaking, instead of 2,000,000 being out of work all the time, 12,000,000 would be out of work some of the time. Every worker would have more leisure and, unless some special source of payment were found, the total available purchasing power would be less than at present by the amount now paid out of the Unemployment Funds. It seems to follow that there is, in theory, no reason why the hundreds of millions now spent on the unemployed should not be spent on the partially employed. In other words, there is already in existence a fund which

might pay for the part-time leisure of all instead of the full-time idleness of a section. That is only theory, but it suggests that we should definitely aim to discover a process by which some such system of Endowed Leisure should replace the present haphazard system of Endowed Idleness. The problem would have to be approached on the assumption that purchasing power must be made commensurate with the goods and services which are available.

In the pre-Machine Age the money paid out in wages and salaries over an indefinite period bore a rough relation to the amount of new wealth produced, and increased or decreased proportionately. To-day, however, it is quite conceivable that, by substituting machinery for men, the production of goods might be doubled and the amount paid out in wages be halved. It is true that in this process the costs of production would be so reduced that the money value of the products would be materially cheapened. But it is obvious that, if a machine costing £1,000 will for ten years do the work of ten men who had previously earned a total of, say, £1,200 a year, the amount of purchasing power withdrawn from circulation is considerable and is unlikely to be compensated by the resultant price-reduction. Many theoretical reforms of our monetary system have been suggested in recent years to solve this problem which has been comprehensively described as "poverty in the midst of plenty". To my mind no solution gets at the root of the matter which does not closely associate the release of purchasing power

with the creation (by machinery) of compulsory leisure. Carried to its logical conclusion this means that ultimately industry, with the assistance of a central or local financing authority, will be responsible for preventing unemployment by a scientific adjustment of working hours and leisure hours. Such a responsibility, however, implies co-operation and co-ordination between the organizations of the employers and those of the employed in a spirit that has not yet been generally attained. We have, however, moved far in the right direction since the beginning of this century, and if the impatience of political theorists is not allowed to interrupt reasonable progress, there is no need to despair of a new system evolving with reasonable rapidity out of the old to meet the new conditions engendered by the growth of machinery. Well-employed leisure, when that time comes, will be part and parcel of our industrial system and the word "unemployment" will have disappeared from our economic vocabulary.

A PRINTER'S VIEWPOINT

By RALPH C. HAZELL

A GENERAL OUTLINE OF THE PRINTING TRADE

IN any attempt to estimate the effects of mechanization in industry, a study of the development of the printing trade in recent years should prove illuminating for several reasons.

It is an industry of medium size employing male and female labour in fairly well-balanced proportions. According to the *Census of Production* (1930), the total number of employees in the Paper, Printing and Stationery Trades in Great Britain was 380,000, of whom about 38 per cent were women. It is a sheltered home industry, not to any serious extent subject to foreign competition nor dependent on the export trade for its prosperity. The home market for its product tends to expand with fair regularity. The development of education increases the demand, not only for school books, but for reading matter of all kinds ; the growth of large manufacturing and trading concerns has resulted in the evolution of national advertising through the medium of newspapers, posters, showcards and catalogues ; and the great increase in recent years in the demand for proprietary goods has led to a very large consumption of cartons, wrappers and similar

printed matter. As a result of these favourable conditions, it is not surprising to find that as production is increased and cheapened by improved machinery, a corresponding increase in demand keeps pace with it. It should further be remarked that, broadly speaking, mechanical improvements in the trade have taken place in fairly gradual stages and only rarely has any single invention caused a serious upheaval in the labour market.

The trade is highly organized and a large proportion of the workers are trade unionists, who are able to negotiate revised or generally improved terms for their labour as new machinery is introduced. Admission to the trade is controlled by the rationing of apprentices, thus avoiding a glut of labour. Wages are relatively high and there are therefore always plenty of young people anxious to enter the trade, with the result that the careful employer can recruit a good stamp of worker.

The trade consists of a large number of firms scattered over the country, the great majority of whom supply more or less local markets in their own areas. Even the so-called "large" firms, who cater to some extent for National needs, are small when compared with those industries which can concentrate their trade on mass production lines in a few large factories or manufacturing centres.¹ Individual orders received are small

¹ In the printing trade about 17 per cent of the employees work in firms employing 1,000 or over, and about 46 per cent are found in firms employing under 200. The corresponding percentages for the chemical trade (although it is a much smaller industry) are 33 per cent and 34 per cent.

and require a great deal of technical supervision. The profits are, generally speaking, modest, but against this they tend to be much steadier than those of many other industries.

For the above reasons, by a study of the printing trade, one may expect to gain a clear view of the effects of mechanization on a progressive industry unaffected by any large-scale process of rationalization or by external disturbing influences such as crises in foreign trade, currency fluctuations, dumping of cheap foreign goods, or similar outside causes, which lead often to great irregularity of employment and to violent fluctuations in profits and prosperity.

DEVELOPMENT OF MECHANIZATION IN THE PRINTING TRADE

Nearly five hundred years ago, in 1440, Gutenberg created a landmark in the history, not only of the printing trade, but of the intellectual development of the World, by setting up in Mainz the first hand press to print from hand-set movable type, and in 1476 Caxton established the first English printing press in Westminster. After this, for some three and a half centuries, printing expanded gradually as a highly skilled hand craft without any radical alteration of method. Movable types were set up by hand and printed from on primitive hand-operated presses, and the printed sheets were folded, sewn and inserted into bindings—often beautiful specimens of hand craftsmanship—with the help only of tools, without the aid of any machinery. Precisely the same

methods were applied to the printing of the first edition of Walter Scott's *Waverley* in 1814 as had been employed for the first editions of Shakespeare's plays about two hundred years earlier.

But the industrial revolution was soon to change all this, just as it changed our social life in so many other ways. The first steam press ever constructed was installed to print *The Times* newspaper in 1814, and this was followed by the gradual introduction of the elaborate range of machinery which is in use to-day and which is being improved and extended year by year. In place of the handwork of little more than one hundred years ago, we have now power-driven composing machines (though with hand-operated keyboards), elaborate printing machines of almost every conceivable style and size, for different classes of work from a postage stamp to a large newspaper or book, and a complete range of very costly specialized machines which divide the binding of an ordinary book into a dozen or more separate processes.

EFFECT OF MECHANIZATION ON THE DEMAND FOR LABOUR

Whatever upheavals may have occurred in other industries, in the printing trade during the nineteenth century increased supply has led to increased demand, and increased demand has in its turn been met by increased supplies of both machinery and labour. Here is no "vicious circle" but rather a beneficent one.

The British Census Returns giving the number

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of workers under the heading of Printers, Binders
and Lithographers, are as follows :—

Year.	Males.	Females.	Total.	Decennial Increase.
				Per cent.
1871 . .	57,484	8,587	66,071	—
1881 . .	74,542	12,941	87,483	32·4
1891 . .	102,082	19,125	121,207	38·5
1901 . .	119,834	29,959	149,793	23·5
1911 . .	140,968	43,107	184,075	23·0

(Note.—During the same period persons classified as Publishers, Booksellers and Newspaper Dealers increased from 14,163 in 1871 to 40,847 in 1911.)

The Census Returns further show that the total population during the period from 1871 to 1911 increased by roughly 66 per cent, and an analysis of the above table reveals the fact that, during the same period, the number of persons describing themselves as Printers, Binders and Lithographers, increased by nearly 150 per cent. It is unfortunate that, owing to an alteration in the classification of trades in subsequent Census Returns, it is not possible to give exactly comparable figures for recent years, but the *Census of Production* statistics for the whole of the workers in the Paper, Printing and Allied Trades, are as follows :—

In 1924 . . .	342,649
In 1930 . . .	380,003

These figures indicate an increase in the total number of employees in the trades mentioned of

about 11 per cent between the years 1924 and 1930. It can, therefore, safely be asserted that during the past sixty years the rate of increase in the number employed in the trade, in spite of the enormous increase in productivity per person, has been very much more rapid than the increase in the population generally.

Unfortunately, however, in spite of a great increase in total employment, this development has sometimes been accompanied by some hardship to individual groups of workers. When the linotype and monotype composing machines were introduced at the end of last century, many of the older compositors, who could only set plain type matter by hand, lost their employment, though ultimately a greater number of younger men, trained in the new methods, found work as a result of the cheapening of the product by the machine.

WAGES, HOURS AND WORKING CONDITIONS

Mass production and subdivision of labour have by no means eliminated the skilled worker from the printing trade. It is true that the all-round man who can compose, print and, if necessary, bind has practically died out, but the trade is now divided into three or four main branches, in each of which skilled journeymen, in some cases assisted by semi-skilled labourers, perform the work or, more often, control very costly and complicated machines. Printing does not call for the endless reproduction of one standard branded commodity, and in operating the modern machines, while there has undoubtedly been some loss of

manual craftsmanship, there still remains the need for a high standard of technical knowledge and mechanical aptitude in "making ready" on the machine and in "minding" it while it is running.

In the great majority of printing works, Trade Union conditions are observed and the skilled workers have retained their status as journeymen and receive wages greatly in excess of those paid a generation or more ago. Before the war the minimum wage of a journeyman in London was under £2, whereas to-day it is £4 9s., and many workers operating special machines receive much more than this under grading schemes. In the case of semi-skilled labourers and women, the proportionate increase in their earnings, compared with pre-war rates, is even higher, and it is therefore clear that after allowing for the increase in the cost of living the worker in the printing trade to-day is considerably better off than formerly.

Labour-saving machinery is often more correctly described to-day as being "labour aiding", and this description undoubtedly applies to many branches of the printing trade. The physical effort of pulling a heavy impression at a large hand press has been replaced by the skilled "minding" of a power-driven printing machine, and the carrying of heavy loads of paper on men's shoulders has been superseded by transport by trucks, which are often electrically propelled. Large machines call not only for heavy capital expenditure, but they need to be housed in modern workshops, and, as a result, stuffy, dirty, gas-lit basements are rapidly being replaced by modern

factories lit by electricity, well ventilated and equipped in a manner to satisfy the requirements of the Home Office Factory Inspector.

Some thirty years ago the standard working week in London was one of 54 hours. This was reduced to 52½ hours in 1901, to 50 in 1911 and to 48 in 1919, so that, in effect, the improved wages quoted above are paid for a week's work which gives the worker one hour more leisure daily. Moreover, in former times the working of very excessive overtime was common and was indeed often desired by the workers to supplement their lower wages. In weekly newspaper houses a regular "all night" once each week (involving continuous employment for about 36 hours except for meals and occasional snatches of sleep) was a very common practice. To-day overtime is very strictly controlled, by agreement between the Employers' Organizations and the Trade Unions, and while printing, owing to its urgent nature, often makes some overtime and spells of pressure unavoidable, broadly speaking, excessive overtime and its consequent overstrain have been abolished.

The thought may occur to the reader that, in view of previous reductions in hours, the question of a further reduction may be ripe for discussion. It is the present writer's personal opinion, that this most important matter will have to be faced before long. It is, however, his view that a reduction in hours should take place in any trade only at a time when it is sufficiently prosperous to be able to adjust itself to the altered conditions,

and to the inevitable increase in manufacturing costs. A reduction in hours introduced at a time when a trade is suffering from severe depression is likely to defeat its own object.

SOME ADVANTAGES AND SOME DRAWBACKS

It is perhaps not sufficiently realized that modern methods of large-scale production tend to create a great number of new types of occupations for people who, under a more primitive industrial system, would have been ordinary manual workers. "When Adam delved and Eve span" or, to be more accurate, sewed fig leaves together, there could be no "gentleman", as everybody had to perform physical labour in order to scrape together a bare existence. To-day many an individual is a very hard worker without necessarily being a "producer" in the narrowest sense of the word. The machine-made requirements of the community are provided for by one section of the population, but it needs a host of other workers to guide the efforts and minister to the needs of the factory producers. Modern society offers employment to such people in great numbers. A factory requires an increasingly large proportion of foremen, technical and other clerks, engineers, an elaborate sales and publicity staff, welfare workers and so on. Then, further, owing to the general increase in the prosperity of the community, more money becomes available for the maintenance of a rapidly increasing number of people who, in various ways, minister to our needs, such as transport workers, electricians, tele-

phone operators, school teachers, hospital staffs, insurance and bank clerks, public officials and many others. There is good reason for believing that, to a very large extent, these new posts are being taken by people recruited from the families of manual workers and that this gradual change is a healthy development.

As to the question of the effects of mechanization on industry generally, it is the writer's personal opinion that there has been a tendency in recent years greatly to exaggerate the responsibility of mechanization, as normally practised, for the serious unemployment which has occurred in certain industries. Mechanization was speeded up to an abnormal extent in certain trades during the war with the result that, after the war, huge, unwanted factories found themselves without work and, in some cases, tried to force their way into peace-time industries with unfortunate results for all concerned. This state of affairs, combined with the post-war collapse of our World export markets, and the attempts now being made to develop a protected home market in its place, account, to a very large extent, for the present position which is, however, gradually working itself towards a solution. In industries like the printing trade, which have not been subjected to these abnormal influences, mechanization has not, in fact, proved to be an insoluble problem.

THE HUMAN FACTOR

In any attempted estimate of advantages and disadvantages we must not lose sight of the human

aspect of the question. It must be obvious that the development of modern machine methods, accompanied inevitably by monotonous repetition, leads sometimes to overstrain of individual workers. It is probable, however, that this occurs more rarely than is commonly supposed. The average young worker learns very quickly to perform simple repetitive movements at a high speed without undue strain. In the writer's view it is a far more serious matter that, in so many trades, mechanization leads not only to a loss of craftsmanship but also to a loss of personal interest and pride in the completed article. If the modern workman is sometimes strangely ignorant or indifferent as to what happens to his product after it has left his machine and performs his job in a spirit of boredom with his eye on the clock, this is probably to a large extent not his own fault. Anyone who is in close touch with factory workers, knows that men who are intelligent and capable at their own work, often have no clear idea of the way their industry as a whole functions, and they frequently resent, because they do not understand, instructions which they receive and which seem to them to be arbitrary or unfair. Managers and Foremen are busy people, often more concerned with seeing that a man gets on with his job than that he should stop and argue about it. Directors are apt to view their employees through the mist of statistical returns and red ink lines on production charts, tempered by an occasional hasty tour of inspection of their factories.

Now it is by no means easy to offer a complete

solution of this difficulty, but it is suggested that in those concerns where, owing to their size, it is physically impossible for the management to maintain a close touch with the employees, personal relations can still be maintained by means of a welfare staff. These officials have no responsibility for the production side, but they come in contact with the staff in connection with first engagements, in cases of sickness or accident, in organizing social gatherings, and in many other ways. In some of the most progressive firms, these duties are combined with work in the field of industrial psychology and include conducting vocational tests, motion study and similar matters. Some firms arrange for parties of their staff to visit other departments accompanied by guides, others circulate information through the medium of house journals or through informal talks or addresses when occasion offers. While efforts of this kind are not always completely successful, it is suggested that, in every factory, it is worth while to make some attempt to interest the worker in something beyond his own particular job.

CONCLUSIONS

This short paper does not pretend to offer more than a general outline of the effects of mechanization in the printing trade. It is suggested, however, that the following conclusions may safely be deduced from the facts already stated :—

The printing trade is a very useful field for investigating the problem of mechanization, because it is an industry which has developed on

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normal and healthy lines, unaffected by outside disturbing influences.

It is clear that mechanization with its cheaper cost of production has led to enormously increased demand and to much more employment both in the industry and also in allied occupations.

Mechanization of printing has not eliminated the skilled worker.

Wages, hours and working conditions of the workers in the Trade have steadily improved, concurrently with, and to a large extent because of, the development of machinery.

Mechanization in the printing trade, as also in most other industries, has led to the creation of a large number of auxiliary occupations, many of which provide work of a non-manual character.

Mechanization inevitably leads to some loss of craftsmanship and tends to create monotonous repetitive work requiring very little thought or even muscular effort. The principal antidotes for this would appear to be improved workshop conditions, shorter hours and the provision of facilities for a fuller and more interesting life outside the factory. Mechanization also sometimes inflicts hardship on individual groups of older workers. The considerate employer has it in his power, at any rate to some extent, to mitigate these disadvantages.

Properly controlled, mechanization is a blessing, and not, as is sometimes suggested, a curse.

MECHANIZATION OF THE COAL-MINING INDUSTRY

By SIR RICHARD A. S. REDMAYNE, K.C.B., M.Sc.,
M.INST.C.E.

HAS it, in the case of Coal-mining—as Lord Trent recently said of industry generally—“ been a reproach in this great age of Scientific development that we have progressed so rapidly on the mechanistic side that we have been unable to keep pace with the humanistic side ”—for these words epitomize the present-day problem of man and the machine in industry ? ¹

In reviewing the position from the point of view of the Coal-mining Industry, we are considering one of the most ancient of British industries, and not only the industry on which is founded our commercial greatness, but that which is the origin and basis of what we know as the Industrial Era, and which, so far as one can foresee, must continue to constitute for civilized man the chief source of power, heat and light. The power requirements of “ the World are continually increasing, and if anything like the same rate of progress is continued, will soon necessitate the consumption of stupendous quantities of coal and

¹ Speech at the twenty-first anniversary of the Institute of Labour Management, London, 16th November, 1934.

oil, which presumably will become increasingly difficult to win and more costly to produce. At the moment the only desire in all lands is to increase consumption of both coal and oil, either to provide employment or to realize capital assets in the lifetime of the owner. Sometime there must come a halt to this procedure, the capital is exhaustible.”¹

The history of the Coal-mining Industry of Great Britain is the history of the industrial era, a period covering less than two hundred years—a span almost negligible in the history of mankind were it not for the momentous developments—material and, I am inclined to think, ethical and æsthetic also—which have characterized it.

Great Britain is the nursery of the Coal-mining Industry of the World, for, even as late as the dawn of the nineteenth century, the coalfields of France, Belgium, Germany and America were practically undeveloped.

Though the art of coal-mining has been practised in Great Britain for, certainly, seven centuries, it was, for many generations, carried on to small extent and with the simplest tools ; and though the scarcity of wood, through the dwindling of the forests in the time of Queen Elizabeth, led to the greater development of the coalfields, little advance was made in the processes employed in mining the coal until the invention of the steam engine by Newcomen in the year 1710. Rudi-mentary appliance though it was, and in reality

¹ Article in *Nature*, 27th October, 1934, on “ The World Power Conference ”.

a "fire engine"—the steam being used only to produce a vacuum—it enabled water to be raised from mines from a greater depth than was hitherto possible. This primitive engine was, according to Switzer, "the beautifullest and most useful engine that any age or country ever yet produced."

Up to this time it had been impossible to work coal much below the depth of free drainage, and in 1610 Sir George Selby informed Parliament that for this reason the coal-mines at Newcastle would not last out "the term of their lease of twenty-one years". Even during the eighteenth century coal lying beyond a depth of 60 fathoms (360 feet) was considered practicably inaccessible. At the present day the practical limit in point of depth is placed at 4,000 feet.

For seventy years from the date of its invention the Newcomen engine was employed almost solely in the drainage of mines, for it was not until that great mechanical engineer, James Watt, had so improved it as to render it almost a new creation that the steam engine came to be employed for the drawing of coal to the surface (1784) and was applied to industries other than that of coal-mining, notably in woollen mills.

Lack of efficient transport was another limiting factor to the expansion of the Coal Industry, for although wooden railways were in use in the North of England from some collieries to the River Tyne as early as 1725, the motive power was the horse. It is a curious fact that so able and far-seeing a mechanical engineer as James Watt

was not a believer in steam locomotion, though he built a steam carriage "to try if God will work a miracle in favour of these carriages!" But the practicability of steam locomotion—like that of flying machines in the latter part of the nineteenth century—persisted in some imaginative minds—

"Soon shall thy arm unconquer'd steam afar
Drag the slow barge, or drive the rapid car,"

wrote Dr. Erasmus Darwin in 1789, moved, probably, to make this prophecy by reason of the appearance in 1784 of Murdock's very elementary steam carriage. It is to Richard Trevethick, the centenary of whose death was commemorated last year (1933) (unhonoured during life like so many other really great and simple souls), that we owe the steam locomotive. Trevethick having built several steam carriages and experimented with them on ordinary roads, on the 24th March, 1802, patented a locomotive for propelling carriages. To this engine a certain David Gilbert, at one time President of the Royal Society, thus referred in a letter to a clergyman friend—"If this contrivance answers to the expectation of many persons well informed on mechanical subjects it will become of great national importance, and assisted by iron railed roads eminently useful to the mining district of Cornwall." So we have probably the first conception of the present world-wide transport system by railway and locomotive. Space does not permit of our following the evolution of the locomotive through its various stages of develop-

ment to the improvements of Hedley and George Stephenson up to the " Rocket " of 1829. At the same time that transport on land by the steam engine was being developed so was steam being applied as the motive power on water.

Remarkable as was the effect of steam in the development of the Coal-mining Industry, on civilization generally it was enormous. We have only to turn to the comparative figures of population and output to see how great was its effect. Thus, whereas the population of Great Britain (so far as we are able to determine) had little more than doubled between the time of Queen Elizabeth and the commencement of the nineteenth century, being in 1811 only 11,070,120 persons, and the output of coal 10,080,300 tons, by 1921 the population had quadrupled, being 47,123,000, and the output of coal was twenty-five times greater, amounting to 255,417,600 tons.

The invention of the steam engine rendered possible the development of many other labour-saving and labour-aiding discoveries and contrivances and their eventual application, with remarkable results, to coal-mining, notably the use of compressed air, and later, the generation and transmission of electrical energy, resulting not only in greatly increased facilities in respect of underground haulage and pumping, but allowing of the realization of the dream of mining engineers, the cutting of coal and its face transportation of the cut coal by mechanical means—a veritable direct replacement of man by the

50 THOSE WHO CONTROL THE MACHINE

machine, for of all forms of manual labour that of hewing coal is the most arduous.

The diagram opposite shows in graphic form the effect of the great expansion which has taken place in the Coal Industry of Great Britain, rendered possible by the application of science to the getting, treatment, and consumption of coal. The great extent to which the mechanical cutting of coal has proceeded in the collieries of Great Britain and America is illustrated by the following figures :—

In 1900 in Great Britain 1·47 per cent and in U.S.A. 24·9 per cent of the coal output was machine cut.

In 1932 in Great Britain 38·00 per cent and in U.S.A. 68·3 per cent of the coal output was machine cut.

The year 1913 witnessed the maximum output of coal, both in this country and the United States of America—the two premier coal-producing countries of the world—since when, for a variety of reasons, the production in both countries has declined.

The consumption of coal per head of population has been, for years, on the up-grade—and probably this is true also of the consumption of nearly all other commodities. The apparent coal consumption per head for the five great coal-producing countries of the world in the record year of 1913 was :—

In the United States of America	. 4·98
„ „ United Kingdom 4·22
„ Belgium 3·44
„ Germany (including brown coal)	. 3·08
„ France 1·44

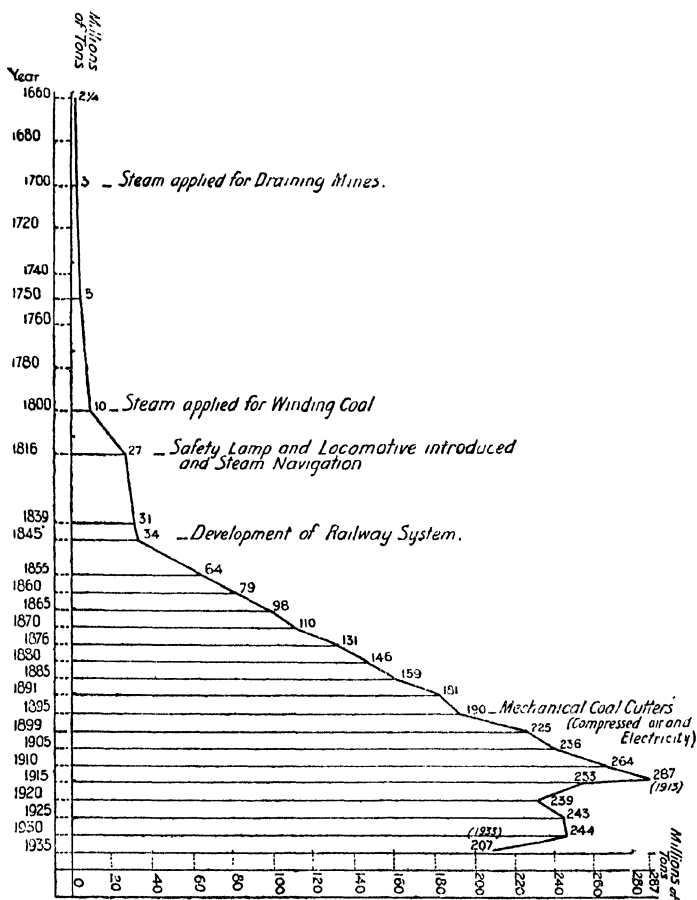


DIAGRAM SHOWING PRODUCTION OF COAL AT VARIOUS PERIODS.

If the coal consumption per head is to be regarded as an index of the commercial prosperity of a country—and, in so far as it is an indication

of output of commodities in general, it may rightly be so regarded—then the United States of America was in 1913 first and France last in the scale. In respect of this aspect of the subject I should like to draw attention to a passage pregnant with economic truth which is contained in the Report of the Electricity Sub-Committee of the Coal Conservation Committee, which Report was issued in 1918. The Committee state that :—

“It is obvious that the improvement in the commercial prosperity of a country—that is the average purchasing power of the individual—depends on increasing the output per head. If wages be raised merely by increasing the selling price of the goods in the home market, there is no real advance, and to increase the selling price of the goods in the neutral and open markets of the world, is hardly possible in view of international competition. The only way to increase prosperity is to increase the net output per head of the workers employed.”

In respect of the Coal-mining Industry at the present time the politicians of this, and some other highly industrialized countries, are pursuing a directly opposite course to that suggested by the above reasoning in that they are seeking to restrict output and enhance selling price.

The cost of production of coal, in spite of all the great developments which have been rendered possible by the advancement in management and the progressive mechanization of mining, has, over a long period of years, shown an upward tendency owing, chiefly, to the increasing wage

bill, and, to some extent, to the more difficult natural conditions inherent to the working of thinner seams and to mining at greater depth. The enhancement of wages cost is consequential upon the increased standard of living which characterizes the mining population—better housing, better clothing and increased leisure. Definite figures as to wage rates of coal-miners for the whole country prior to the nineteenth century are difficult, if not impossible, of ascertainment, but if we take the great Northern Coalfield as an example—and it is a good one, for it was the nursery of coal-mining—that class of worker known as the coal-hewer, the actual getter of the coal (then as now constituting about one-half of the underground staff of a colliery), we will find that the average wage at the beginning of the eighteenth century was from 1s. 2d. to 1s. 6d. for a shift of an indefinite and variable length. One hundred years later the wage had about doubled, being 2s. 10d. per shift of twelve hours : and at the end of last century it had about doubled again, and the hours worked per shift had been materially reduced. By 1934 the increment in wage showed an advance of over 70 per cent on the average ruling at the end of the nineteenth century. That is to say that over a period of two hundred and thirty-four years the augmentation of the average wage of the coal-hewer has amounted to 778 per cent, or is nearly eight times what it was when first recorded, and the hours of work have been materially reduced, being now only seven and a half.

Costs of working coal in the early years of the industry are impossible to come by, but the average cost (into wagon at the pit) during the eighteenth century was under 3s. per ton—if we regard the costs at a number of (at that time) large collieries as indicative of the whole country—but increased materially in the early years of the nineteenth century, being about 4s. 8d. per ton in 1834, and in 1879 from 5s. 2d. to 5s. 4d. per ton. In 1905 a fair average working cost was 6s. per ton, and in 1913, the last year before the Great War (and a year of considerable activity and good prices in industry generally), the average cost for the whole of Great Britain was 9s. 5½d. per ton. At the present time it is 13s. 3·76d. per ton (year ended 31st December, 1933), or an increase in one hundred years of 186 per cent.

What the profits have been in the remote past it is hard to say, but that great fortunes were amassed—and also heavy losses incurred—one reads of in the history of the industry. But we do know that the average profit per ton at the commencement of the present century was 1s. 2d., whereas the average profit for last year (1933) was only 3d. (2·83d.), on an average selling price of 13s. 6·56d. In other words, cost of production had increased 77 per cent, wages 71 per cent and profits had decreased 78 per cent as between 1908 and 1933.

Artificial restriction and the endeavour to fix selling prices by law, which have been operative in the Coal Industry of this country for some years, have had, in my opinion, a most injurious

effect on the industry and have caused the march of progress—using the word in its broadest sense—to hesitate and falter. Production should be centred at the most economically worked pits with unrestricted output, so allowing of low working costs and cheap coal with consequent enhancement of demand. The present restrictive attitude is tantamount to the insertion of a spoke in the wheel of rationalization and mechanization of colliery practice. The policy adopted is one of sterilization of the fit in order that the unfit may be kept in existence. The restriction process has been tried before in the coal trade—as far back as the time of Cromwell—and has always failed and must always fail, based as it is upon false economic doctrine.

Unemployment and reduction of hours of work are two questions which have for some years occupied a prominent place in the minds of thoughtful men. It is agreed, and with a large modicum of truth, that the application of “rationalization”—another name for planned efficiency—to industry is correlative with a reduction of personnel or, alternatively, a reduction of working hours if the rate of pay per head is to be maintained. In some industries, notably such in which production and distribution are vested in one and the same concern and in which the item of labour cost does not constitute a high proportion of the selling price of the commodity produced, it has been found possible, with increased mechanization and planned efficiency, to maintain the full complement of workers by a reduction of hours

worked per week without increasing the selling price of the commodities manufactured or enhancement of cost of production. But in the Coal-mining Industry, and, indeed, in all industrial undertakings engaged in the production of raw materials, e.g. fuel of all sorts, metalliferous ores and building materials, the case is a much more difficult one. In coal-mining the proportion of wages cost to selling price per ton is 64 per cent.

To prophesy is dangerous, to dogmatize is fatal, but in an unfettered coal industry it is conceivable that, in process of time, costs could be reduced by skilled management, and the still wider application of scientific methods in the getting of coal and the simplification of distribution—possibly the latter holds out most hope of amelioration, for the cost of distribution at present is, in many cases, considerably greater than the cost of producing the coal, a fact not commonly realized by the British public—more efficient distribution would permit of a lowering of the selling price, allow of a greater profit being earned per ton, and conduce to an enhanced demand.

To sum up the situation. We have seen that the growth of mechanization in the Coal-mining Industry has, during the last two hundred years, and especially during the last fifty years, been very great, and to the workers mechanization has proved a veritable *Deus ex machina* in that the benefit accruing therefrom has largely been transmitted to them, in the form of enhanced wages and reduced

hours of work, and there can be little doubt that this process will prove to be a continuing one—slower perhaps than in respect of those industries which are not concerned with the production of raw materials, but still more or less persistent in this as in all branches of industrial activity. And so, in course of time, something approximating to Socialism—or rather, let us say, social equalization—will eventuate, not through state interference, for state socialism is a policy doomed, by its inherent defects, to failure, but by the natural evolution of industry on lines more akin to Guild Socialism—a levelling up of the masses rendered possible largely through the agency of mechanization—the manual worker being gradually replaced by a machine director, the unemployment otherwise consequent upon the extension of rationalization being obliterated by the counterbalancing effect of the shorter hours worked per employee and the greater leisure and increasing standard of living demanded by the community intensifying the demand for commodities. The problem of the future, as the result of this *Deus ex machina*, may well be that of the use to which the increased leisure of the individual should be put, rather than with the acquisition of the leisure itself. Personally, I have no fear on this score. The advance made in the manner of life, as well as in their circumstances, of the miners since the time when I first became engaged in coal-mining—fifty-one years ago—has been very considerable. Both from the educational and cultural points of view, the state of the mining com-

munity is very different from that of my early years, which is, of course, true of all classes of the community, for wealth—using the term in its fullest sense—has not only increased but is more evenly distributed.

PART II

THOSE WHOM THE MACHINE
CONTROLS

THE MINER

By A. VARLEY

TWENTY years ago, whenever workers met in their national conferences, it was a commonplace for speakers to refer to the coal-miner as the "almighty collier". The miner himself did not object to this ; he was rather proud of it. He was numerous, well organized in his trade union, and strongly represented in the House of Commons. To him, the workers in other industries were more or less necessary, but, since they were not miners, they must be, on the whole, rather "poor fish". His was a job where the weakling had no place ; exhausting, dangerous ; of the very vitals of national existence ; a hundred-percent man's job. To-day, however, he is no longer the "almighty collier" ; least of all, perhaps to himself. His self-confidence and the great belief in his own superiority have been rudely shaken. Once, in his industry, he was The factor that mattered ; to-day he is not so sure about that. The machine has come to challenge him and already he begins to feel he is destined to "run a poor second". Not that the displacement of labour by machinery in any one mine has been so very severe. What has taken place already is that smaller and less efficient

mines have been closed altogether, while capital and effort are being concentrated upon larger concerns where the thicker and more easily "got" coal-beds lie.

On 10th August, 1934, the *Colliery Guardian* said: "It is satisfactory to find that the use of machinery in British mines made further progress in 1933. In that year no less than 42 per cent of the output of coal was got by machinery as compared with 38 per cent in 1932. The advance has been steady from the beginning of the century when the percentage of output was no more than 12". It is very important to note the word "got" in the above quotation. The "42 per cent" has reference only to the proportion of coal undermined, or "holed" by machinery, and takes no count of the extent to which mechanization of other processes in and about the mine has developed—haulage, mechanical boring machines, mechanical picks, and in the cleaning and grading of coal. It should be remembered that the number of non-coal-face workers is far greater than that of the coal-face men, and that, therefore, the 42 per cent is not by any means the whole of the story of mechanization in the industry. Take the surface-work—the cleaning and grading of the coal. Here the mechanization is almost everywhere complete. At some pits, as recently as 1920, this class of work was almost entirely done by hand. The coal from the pit-wagons or "tubs", as they are called, was unloaded into the railway wagons with the "hand-screen"—a large fork which separated the larger coal from the

“slack”. The work was hard, disagreeable, and very monotonous, and could be performed only by strong adult workers. To-day, the visitor to one of the most modern plants would see the “tubs”, as they reach the top of the shaft, pushed from the cage by rams, and gravitate to an endless chain or “creeper”. The “creeper”, running under the “tubs”, is armed with “horns” which engage the axles of the “tubs” and move them along to an automatic “tipper”—a revolving drum-shaped frame fitted with rails to receive the “tubs”. The full “tub” pushes the empty one from the “tipper”, operates a catch, is somersaulted and, in its turn, pushed from the frame and conveyed back to the shaft by means of another “creeper”. The falling coal is received into a huge sieve or “shaker”, which with a rapid to-and-fro movement performs the first step in the coal-grading, the larger coal sliding forward to one conveyor, and the smaller falling through the “shaker” to another conveyor traveling below. As the mineral passes slowly along the conveyors, it is cleaned and sorted according to size and quality, and finally falls into the appropriate railway wagon stationed below. This part of the mechanization has abolished much laborious and monotonous work and may be counted as an important gain to all concerned. The greater part of the work can now fairly easily be done by boys from 14 to 18 years of age.

Before the layman can appreciate what machine-mining has meant to the collier, it is necessary to say something about the hand-got system.

Under this method, a production unit, or "stall", usually consists of from 40 to 50 yards of coal-face frontage, each "stall" approached by its own independent roadway, or "gate". A letter T will give an idea of the "stall", the stem of the letter representing the "gate", and the horizontal the extent of face allotted to each working group. In the larger pits the group numbers six to ten men—say about half of the men contractors paid by tonnage, and half day-wage men who are paid by the contractors, or "butties" as they are called.

The two most usual methods of "getting" or breaking the coal from the seam are "ragging" and "holing". Under the "ragging" system, the face is so aligned as to form an angle of 45 degrees with the grain of the coal. With the "line of attack" meeting the grain at this angle, the natural "squeeze" between roof and floor causes blocks of coal to burst from the face, and, normally, the "getter" has only to keep the foot of the face free of impediment to be kept busy filling his "tub" with the coal. Very little undermining is necessary. The great drawback, however, with this method is, especially in the more friable seams, that a fairly severe "squeeze" will cause a yield of too much "slack" and too little large coal.

With the "holing" system, the advance is made head-on to the grain of coal, and here the "squeeze" causes little or no burst. The face is undermined to a depth of about 4 feet 6 inches, the over-hanging coal being kept in place by short

wooden supports or "sprags". When a convenient stretch of face has been "holed", the supports are withdrawn, and the coal, if not broken by its own weight, is brought to the floor by wedges or by blasting, and so filled into the "tubs" for transport to the "gate", and then away to the bottom of the shaft. In the machine-mined unit, the length of face is not 50 yards, but anything from 100 yards to round about 400 yards. This extension of the unit-frontage means, of course, an important economy in "gates". In the more modern plants, conveyors have displaced the "tub" as means of transport at and near the face, and this, considered by itself, has been voted a real boon by many colliers. The rails on the face, it should be remembered, were never in one place more than a few days at most, and therefore the track had never time to become stable. Derailments of "tubs" were frequent; the roof or the props on either side of the roadway had often to be cut in order to allow the "tub" to pass on its journey, and, in case of a runaway wagon, there was little time and space in which to seek safety. Crushed and broken limbs were common, and scarcely a man would regret that the "tub" is being restricted to the "gates" and main roadways, where the track is relatively stable and where there is standing room.

Under the hand-worked system, the miner was "Jack of all Trades". He holed the face, drilled shot-holes, filled coal, withdrew unwanted props, built walls or "packs" in the waste after the coal had been "got", dismantled the old track, laid

the new one, and “ripped” or increased the height of the “gate”, in order to permit the pony to pass. No job came amiss to him; indeed he greatly welcomed a change of task now and then. Under the new system, however, the men are arranged in specialist groups: cutters, hewers, and packers. The cutters usually work through the night; the coal is “got” and dispatched by the day-shift; while the packers and others occupy the face during the remainder of the 24-hours’ programme.

Now, to arrange a programme is a fairly easy matter: to carry it out in a coal-pit is not nearly so easy. The great drawback is the extreme instability of working conditions from hour to hour. A Derbyshire miner would say: “Machinery’s aw reight when it is aw reight, but it’s nivver aw reight.” Breakdowns and delays are very frequent. A fall of roof, the fusing of some part of the power installation, the failure of current from above-ground, the tearing of the conveyor or the breaking of its hinges, an inrush of water—any one of a score of things may happen to bring the work of a few score men to a standstill, sometimes for an hour or more. Quite unlike the old system of small, independent “stalls”, a delay at one point of the conveyor is a delay for every man of the greatly enlarged working team. The programme is arranged so that with the best of good fortune the shift may complete its allotted task in $7\frac{1}{2}$ hours or thereabouts—the statutory length of the shift. But fortune is so seldom “best” for any considerable

length of time. It is clear that the cutting-machine cannot proceed on its next journey along the face until all the coal of the preceding "cut" has been broken down, and sent on the conveyor into the waiting "tubs" in the "gate". The regular time for the hewers to cease work arrives, but owing to a breakdown which has occurred in the course of their shift, their set task is not completed. Overtime must be made, sometimes for additional wage-payment: not infrequently without. It is no uncommon experience nowadays for machine-work miners to be virtually compelled to pass 10, 12, and sometimes 15 hours under ground at a stretch, as some panel-doctors in the Midlands have good reason to know. The men for the most part are too weakly organized to resist; indeed many dare not even complain. With roughly a quarter of a million miners waiting for work under almost any conditions, a man, and especially a married man, is not in a great hurry to complain of working conditions.

But the hewer's trouble is by no means the last one. A delay for one shift is a delay for all; the whole of the 24-hour plan is thrown out of gear. The afternoon shift reaching the pit-head, say, at 3 p.m., may be told that, because of the breakdown on the day-shift, they are not required until 5 or 6 p.m., and fairly often a man, from this cause alone, is dressed in his stiff, uncomfortable, sour-smelling working-clothes two or three hours longer than the one-time normal. Not altogether unnaturally, the men become irritated, resentful, embittered. Each shift will blame the others, or

the staff, for the dislocation, and bickerings and quarrels ensue.

Before the coming of the coal-cutter, the men as a rule left the place at the statutory time for cessation of work. Now the watchword is "The programme ; speed ", and additional deputies are appointed so that the men shall be under constant supervision and kept keyed up to top pressure. Time was once when a colliery deputy was appointed for his intimate knowledge of the practical side of mining and for his tact in dealing with those in his charge. First and foremost he was the guardian of personal safety ; all other functions were secondary to that. To-day, few machine-work miners would agree that a deputy's chief concern is the safety of his men. It is true that his salary does not directly depend upon output of coal, but it is equally true that his standing with the management depends upon his capacity to extract the maximum of work from his men for the minimum of wage-payment. It is impossible to reconcile maximum output and maximum safety of life and limb. Many people entirely unconnected with the coal trade will agree that it is high time that colliery deputies were paid by the Government and held responsible to the public for the safety of their subordinates.

Under the old system a hewer would generally take reasonable care to fill into his " tub " only saleable coal, but now the objective is not so much the filling of clean material as to make a free space for the passing of the machine on its next journey. The " cut " must be dispatched in time ; one can-

not be troubled to sort out the combustible from the non-combustible. At the commencement of the shift each man is faced with his own particular task. The "holed" coal is marked out in "stints" of longer or shorter frontage according to the thickness of the seam. Let the reader multiply about 20 feet of frontage by 4 feet in height of seam by 4 feet 6 inches of forward undermined depth, and that will present an idea of the block of coal awaiting each man. Add to that the setting of props and the final timbering which will constitute the new roadway along the face; that is the hewer's average day's work. He cannot maintain top speed throughout the day and carefully sort the rubbish from the coal. Dirty coal, then, is sent to the surface. The cleaners are unable to extract all the rubbish in the time available. Merchants complain of unsaleable coal; orders are lost to the colliery company. The offenders at the face are sought out and disciplinary action, by fines or dismissals, is imposed. So, between the devil of the urge to speed and the deep sea of fines or unemployment, the coal-hewer is often in a very unenviable position indeed. Furthermore, from the point of view of safety, a coal-mine is one of the last places where slap-dash methods should be tolerated; much less should they be encouraged. But bustle and slap-dash are the order of the day, and the old-time miner loathes it.

But very soon, however, it seems that the industry will not need him. Youthful brawn is taking his place; the day of the steady, conscien-

tious plodder is on the wane. To-day it is no easy matter for a man of 50 years to find a job in a coal-mine; indeed men are turned away as "too old" even at 45. Nor, if truth must be told, are many middle-aged unemployed miners particularly anxious to find a job on a machine-cut face. Their chief concern is, if possible, to find suitable work away from the pits altogether, and although miners have been regarded as among the most clannish and the least mobile of the labouring classes, thousands of couples are prepared to make, and are making, the most heroic sacrifices in order to withhold their boys from the mines. Twenty years ago, son followed father into the pit unquestioningly, and generally with enthusiasm. There was romance, adventure; something fine and manly and brave about a boy's descent to the bowels of the earth to tackle a difficult and dangerous job—with a pony, too! Nowadays, however, that enthusiasm is a much rarer thing. The boy has been longer at school; reads the daily paper; is much more man-of-the-world than his father was at the same age. Often he has travelled farther and seen more of his fellow-countrymen and their doings at 14 years of age than his forbears had at 21, and the prospect of joining an industry in which unemployment hovers round 30 per cent, in which the average weekly list of fatalities for 1933 numbered nearly 16, and in which the average wage-income was only a little more than £2 per week, is accepted only when every other reasonable avenue is closed.

Perhaps the mother is more anxious than the

father to keep her sons "awee from t'pit", as she would say. She hates the innovation. Once her husband is in the mine, she can never feel sure at what time, to several hours, he may return. She prepares his dinner for 3 or 3.30 p.m., and the reader can well imagine how stale and unappetizing that meal may be to a weary, discontented fellow returning home at, say, 7 or 8 p.m. Small wonder that the miner's wife hopes that her boy may not be compelled to follow his father into the machine-work pit. Her man is "not the same". He is restless, "nervy", irritable; does not sleep as he used to. The specialization and regimentation, the measured "stint" awaiting him, the speeding up and the grind and rattle of machinery have "got into his system". His output is definitely on the up-grade; his wage is not. He was once proud of his skill as a pick-man; that pride is rapidly passing. He regards the coal-cutting machine much as one of the "Light Brigade" would regard the developing mechanization of the Army. Once he felt he was a personality with a name; now he fears he is a cog with a number. The machine may have lightened a task or two here and there, but this he regards as merely incidental; it was not so intended in the plan.

The present generation, born into an age of syncopation, accept the machine as they accept wireless, aviation, and American films; they do not question much; they cannot make comparisons; for them these things are the normal. But if all those in the coal industry, officials and

men, who have known and worked in more leisurely days and yet are contented with machine-mining, could be collected into one village, it is extremely doubtful if the muster would be strong enough to work one modern colliery.

Has the machine tended to make the mine a safer place for miners? No. The increase of explosive dust, the bustle and noise, and the presence of electric cables, switches and joint-boxes can never make a mine a safer place.

Has the machine tended to shorten the miner's working shift? The tendency is very definitely in the opposite direction at present.

Is it likely that the miner will benefit financially from the change? There is little or no evidence to cause him to believe that he may.

Is there anyone, master or man, at work or at home any happier for the advent of machine-mining? That is very, very doubtful.

THE ENGINEER

By W. FERRIE

ANYONE attempting to discuss the question of Man and the Machine is more often than not casually dismissed as an antiquated old fossil, who is opposed to the introduction of scientific methods of production of all the necessary means of life which the human mind can conceive and which the human body can consume.

In this short chapter I shall endeavour to put forward a different point of view, a point of view which is actuated by a desire to see scientific methods applied to every phase of modern production which would benefit mankind in every possible way and yet not subject it to all the evils which modern production now exercises on the human mind and body ; and then I want to ask my readers whether science is being used in the interest of humanity, and if not, have we, who proudly boast of our cultured civilization, become mentally deranged ?

The tremendous development in the production of commodities can be estimated by the following extract from the preface to Professor Spooner's book, *Wealth from Waste*, written by Lord Leverhulme :—

“ With the means that science has already

placed at our disposal we might provide for all the wants of each of us in food, shelter and clothing' by one hour's work per week for each of us from school age to dotage."

So writes this noble lord, and then the average person wonders why there are over two million unemployed in this country alone, and whether the results of scientific research are actually being utilized to the full in the methods of production, and, if so, who benefits.

There are many factories which are not equipped with the latest models and machine tools ; there are many which can claim to be the acme of perfection in this respect. There are many factories which, although they do not boast of their equipment in so far as tools are concerned, are specially equipped for a high individual productive capacity as a result of the scientific elimination of waste movements applied to the human body. Of course there are factories which combine these two methods in the production of their commodities.

In those factories where the latest type of machinery is coupled with the results of the Physical and the Psychological industrial laboratories, the mental and physical strain upon the worker is severe to a degree, and is explained by Fordism as : There is a difference between working hard and making hard work of a job. With the result that in the United States from 1919 to 1927 the total industrial production increased by 30·5 per cent, but the number of workers employed in manufacture decreased by 950,000.

One may say that this only applies to the United States, but let us come right home and examine some figures in relation to the motor-car industry in this country. Each year *Engineering* publishes a survey of the engineering industry, and from this data we find that the number of workers employed in the motor section of the industry had increased by 23 per cent in 1933 over that of 1923, whilst the production of cars and commercial vehicles had increased by 201 per cent. Still more significant are the figures relating to 1929 and 1933. In 1929 some 227,796 persons were employed and were responsible for the production of 239,923 vehicles—a record production for Great Britain. This record was easily surpassed in 1933 when 217,552 work-people produced 286,283 vehicles. Compare these figures with those of the year 1929 and we find that the number employed had *decreased* by more than 10,000 whilst the production of vehicles had *increased* by 46,360.

It is very often suggested that rationalization has only been introduced into large-scale production in the heavy industries, but if one actually looks around one can observe rationalization methods being introduced in all spheres of work, i.e. from road construction to barber shops, huge steel works to slaughterhouses. We will quote two examples. A slaughterhouse equipped on the American pattern now employs 22 slaughterers and 15 assistants to kill and dress 1,000 pigs in eight hours, whereas 150 were formerly required to do the same work in the same time. Another example of slaughter can also be quoted. Before the War

a factory in Saxony employed 46 workers to make 4,000 mouse-traps a day ; under the new system 15 girls turn out 10,000 a day. Now for a piece of sugar ! In a sugar refinery, unloading mechanism controlled by a single man does the work of a gang of twenty.

Reverting to the motor-car industry in this country, which because of the necessity for reproduction on a large scale lends itself to rationalization and mass-production methods, we shall be able to see the rapid strides made by some of the largest manufacturers in England. In an article which appeared in the *Star* on 14th January, 1932, Mr. J. Harrison asserts that "Mr. C. R. F. Englebach, a director of the Austin Motor Company Limited, stated that the number of employees per week per car at his factory fell from 55 in 1922 to 24 in 1923, 20 in 1924, 17 in 1925, 12 in 1926 and 10 in 1927, and *that this figure has since been considerably reduced*".

How are such amazing results possible ? The answer to such a query is generally "Rationalization of industry". And there are many and varied explanations for the term "rationalization". In 1931 the International Labour Office (League of Nations) published a book on *The Social Aspects of Rationalization* from which we may be permitted to extract the following :—"In what, then, does this rationalization movement, so characteristic of the present day, consist ? In the systematic effort to get the most out of the resources—labour and materials—employed in the various economic activities. Rationalization means that instead of

traditional processes, established routine, empirical rules and improvisation, use is made of methods that are the fruit of patient scientific study and aim at the optimum adjustment of means to ends, thus securing that every effort produces the maximum useful results."

It was because of the introduction of such a "systematic effort to get the most out of the resources—labour and materials", especially labour, that 10,000 Austin workers struck work in 1928!

The world economic crisis has caused the intensification of the exploitation of the human being engaged in industry. In the endeavour to capture the markets of the world, science has not been harnessed to give relief to mankind. On the contrary it has been responsible for the intensification of anguish, both mental and physical torture, never before experienced in the day-to-day lives of millions who earn their living in the production of the necessities of life.

The main objective in the lives of employers is to produce cheaply, and in the process of cheap production a great deal of attention is paid to the methods of production, especially the exploitation of human labour power, or put in other words : " the systematic effort to get the most out of the resources—labour and materials—employed in the various economic activities ".

In some factories expensive and up-to-date machinery has been installed, whilst in others it is claimed that high-production machines cannot be economically used in this country, and we therefore find that the rationalization of industry in

this country has taken—in the main—the form of the systematic effort to get the most out of labour, i.e. conveyor systems, chain work, selection of workers, the training of workers, Bedaux systems and Time Study. Both the Bedaux System and Time Study aim at the elimination of all waste movements in the process of production, and very often working times are not fixed in a really scientific manner and fatigue is not taken into account. Mr. B. Seeböhm Rountree has said on this point : “Much of the objection to time study in the past has been due to the fact that it has been carried out too mechanically as though the workers were inanimate machines.”

The selection of workers and the training of workers on the basis of formulæ arrived at in the industrial psychological research laboratories has eliminated the necessity for long periods of apprenticeship, although the employers maintain the apprentice period for the purpose of low wages. Those employers who deny this contention will be obliged to Mr. Ford for the following information, that the training for a job requires for 43 per cent of the tasks not more than one day, for 36 per cent one to eight days, for 6 per cent one to two weeks, for 14 per cent one month to a year, and for one per cent up to six years. With modern methods of production, i.e. the simplification of the labour process, the scientific selection of the worker, the need for vocational training is limited to a tiny proportion of the workers, as compared to pre-War days and even early post-War days.

The progress of machine tool production has eliminated a great majority of the old-time craftsmen from the modern workshop and in their places there exists a new type of craftsman, who has the necessary dexterity for the manipulation of machine tools and has been selected because his psychological temperament is suited for mass production.

Not only does this apply to factory life, it also applies to office life as well. As Dr. Paul Gerster stated in the journal, *Betriebe und Organization* : "The use of accounting machines compels the complete reorganization of the accounting department. It is hardly possible merely to tell off men hitherto employed on accounting work, to operate these machines. On the contrary, their manipulation requires a person who, while possessing some knowledge of accountancy, is above all skilled in the use of machines." Thus the introduction of mechanized accountancy has been instrumental in displacing the one-time highly skilled office worker. According to a special inquiry undertaken by the Ministry of Labour in the autumn of 1925, of a total of 55,978 salaried employees out of work, 24,028 were higher-grade employees.

So science has been harnessed to displace labour in every direction with no compensation to labour whatsoever. True, some few, very few individuals may claim some higher reward for services rendered, but never in proportion to the percentage of increased production. Let us take one or two examples of increased production. "In the Bethlehem Steel Company 'scientific selection' was

tried with a shift of 75 pig-iron chargers, and only one worker out of eight was kept, because only this small minority was physically able to handle $47\frac{1}{2}$ tons of pig-iron per day, which was found by scientific study to be the normal for a suitable worker. . . . When the selected workers had been trained the desired daily output of $47\frac{1}{2}$ tons was obtained, instead of $12\frac{1}{2}$ tons formerly."

Not only is production speeded up by a careful selection of workers, it is greatly accelerated by the elimination of all waste movements. "In the work of assembling carburettors motion study led to reduction in the time required from 450 minutes to 45 minutes; for assembling small carburettors from 420 to 60 minutes; and for assembling pumps from 360 to 60 minutes" (L. M. Elbreth, *Training Employees in Production*). Great attention has been paid to the importance of rhythm in movements—"rhythmical work" or work in which the worker "sways to the rhythm of the chain", says Mr. H. Hultzsch. Rhythm has been introduced into the coal-mine. "In coal-mines, miners were taught to use their pick rhythmically, to strike strongly and more quickly when dealing with hard rock. Since they lost a great deal of energy by stopping the pick and beginning a fresh movement to bring it back, they were taught to use a circular movement whenever possible and so avoid the necessary effort required for stopping and starting again. These changes, along with one or two others, led to an increase of 16 per cent in output" (*The Social Aspects of Rationalization*).

In this age of modern production when science has been applied to the production of machine tools and to the scientific management as well, and when the ownership of such tools are in the hands of unscrupulous private employers, to whom mankind is compelled to sell his power to labour, we are forced to argue with the American Professor, Robert Franklin Hoxie, who wrote on the subject of scientific management as follows :—

“ . . . It is destructive of mechanical education and skill ; splits up the work into a series of minute tasks, tending to confine the workers to the continuous performance of one of these tasks ; tends to eliminate skilled crafts ; deprives the worker of the opportunity of learning a trade ; degrades the skilled workers to the condition of the less skilled ; displaces skilled workers and forces them into competition with the less skilled ; narrows the competitive field and weakens the bargaining strength of the workers through specialization of the task and the destruction of craft skill. . . .

“ Finally, scientific management, in its essential nature and unsupplemented, seems to be a force tending to reduce the great body of workers to a little-skilled, practically interchangeable and unorganized mass, with all this implies with respect to possible insecurity and discontinuity of employment, wage levelling and the mental quality of the workers.”

And yet, Lord Leverhulme, in writing the preface to *Wealth and Wants*, states : “ With the means that science has already placed at our

disposal, we might provide for all the wants of each of us in food, shelter and clothing by one hour's work per week for each of us from school age to dotage."

Science has brought small relief to mankind under the existing order of society ; only unemployment and short time with its subsequent loss of wages, economic insecurity, physical and mental torture. The question therefore arises to millions of work-people in every sphere of economic activity—Shall we scrap science before science scraps the great majority of the human race? If we adopted this attitude then we should be reactionary, stupid and deserve to be characterized as Luddites.

Science should be utilized for the benefit of mankind in general. Each invention should be exploited to the utmost capacity in order to relieve the irksome monotony of labour, to reduce the hours of labour to provide for greater cultural development of mankind. At the moment there is only one country in the world where science is encouraged 100 per cent, where the great majority of people do not live in constant fear of some new machine which will throw them on to the streets—that country is the Soviet Union, where private property as we understand the term has been abolished, and where the "systematic effort to get the most out of the resources—labour and materials" is not only adopted to the full but is definitely encouraged in the interest of science, culture and mankind in general.

THE STEEL WORKER

BY WILLIAM GREGORY

SPEED. I think this word is the most used word in the English language. People can only think and measure things in terms of Speed. We are all familiar with the phrases, "How fast does it go?"—"How many hours has it taken you?" We have ceased to think in terms of quality. I want to try and show in this Essay how "Speed" has affected the people engaged in the Industry of Engineering.

I will try to sketch a picture of the "good old days" before the War. The fitter, turner or skilled machinist was then called a journeyman. He usually had served seven years' apprenticeship, during which time his wages rose from about 4s. to 12s. when he was 21. Then in steep rises, during the next two years, his wages rose to about 38s. This was a good wage for pre-War years. Thousands of men of other trades were only earning between 18s. and 26s. a week. The engineer was the aristocrat of industry. In the shop he either wore a peak cap or a hard bowler hat and blue overalls. He always had a large tool chest full of tools and "gadgets" which were mostly "home-made". He was very proud of his kit of tools. He walked about with an air of importance, and would

proudly show his club card and vie with others as to the length of membership in the Associated Society of Engineers. He was keen on his craft and would soon question the foreman if the latter was starting too many apprentices, or putting unskilled labour on a new machine. If a labourer picked up a file, the craftsmen soon told him to put it down. At meal times the fitters and turners "dined" at one end of the shop, while the labourers ate at the other. The craftsman usually read the Tory paper while the labourer read the Liberal. These craftsmen were terrors for fighting on the industrial field. As far back as 1898 they stood back to back for a solid nine months in a strike for an eight-hour day. But on the political field they were mainly "Tories". They saw no similarity between trade unions and politics. They experienced very little unemployment, and it was usual for a man to spend years in one job. So long as he did his work correctly, the "boss" was satisfied.

For a boy to become an engineer he had to be apprenticed. An agreement between the masters and the unions stated that there was to be one apprentice to five journeymen. The boy had to sign an agreement that he would stay with the firm until he was 21 and work for a stated wage. The firm agreed to teach him a trade and also give him certain fixed holidays a year. The apprentice had an easy time and was given every opportunity to get used to the tools. Later on, from time to time, men would stop to show him the intricate parts of the trade. The apprentice

on entering the shop had to stand a little "leg pulling". It was usual to send the new lad for the leather punch, a left-handed spanner or a bucket of steam. This caused much laughter, and the apprentice would wait until the next new boy came and he would play the same tricks on him. When a youth came out of his time he would stand "foot ale" for his mates.

In the pre-War shop, the emphasis was not on speed, but on craftsmanship. When you had finished a job you felt you had created something, whereas to-day, after finishing a job, you see something that represents a number of hours. You may feel disgusted with the job, but it is the best you could do with the number of hours at your disposal. This speeding up has caused men to lose interest in craftsmanship.

The engineers feel that they made a sad mistake when they agreed to dilution of labour during the War. Attention was focussed on this industry owing to its key position. The Government drafted clever men to organize it. The inventors not only designed new machinery but also simplified the complex operations. This enabled less skilled labour to be employed. The skilled workmen only agreed to dilution of labour after an appeal to their patriotism, and after they had been given promises of security after the War. As the engineers were exempted from War Service, there were hosts of people who wanted to enter the trade. This was their opportunity and the newcomers included publicans, insurance agents, bricklayers, joiners, Corporation employees and

agricultural labourers. The humour of it was that these people got the best jobs and earned anything from £10 to £15 a week. The craftsmen, who were on £5 a week, sometimes got jealous of these "new-comers", and asked for jobs on machines. But the boss used to tell them to be satisfied as that "crowd" would get the sack when the War ended, and they would be kept on.

Before the War the standard of work depended on the amount of skill the craftsman possessed. Some men were clever at casting brass bearings. Others were good at fitting bearings. They could not tell you why they were so good at these jobs. It just came to them naturally. Others had large tool boxes full of all kinds of "gadgets". With these they did all manner of tricky jobs. During the War the advancement of machinery displaced the inherent skill of the tradesman. The machine was so developed that it made much of this skill unnecessary. So we can look on the War as a period when the importance of a craft was changed from men to machinery.

From 1922 onwards there has been a feverish attempt to develop machinery. The idea is to break up the operations and make them as simple as possible. I think the employers have succeeded in this attempt. The old type of centre lathe, on which you could screw, cut, turn, bore or drill, has been superseded by the automatic lathe. This lathe does not hold its work between centres, but holds it in a chuck. The lathe is so built that numerous kinds of operations can be

done without removing the job. For production work it is ideal.

But it would be difficult to get exact finish on these automatic lathes in reasonable time. So this has meant the development of the grinding machine. Carborundum stones which were little used before the War are now common in every shop. Jobs which previously would have been filed and finished with emery cloth are now put on the grinding machine. It is cheaper, quicker and more accurate.

The time spent on machining must easily have been reduced quite 50 per cent to 70 per cent compared with pre-War times. I will give some examples of what these machines are capable of doing. A Churchill centreless grinder will grind 600 one-eighth drills per hour. It is also capable of grinding 180 stub axles, removing 0.020 in material, per hour. Here the speed of these machines does not give the operator much chance to waste time. From my own experience I have seen times and prices reduced 50 per cent on certain jobs. The British Northrop Loom Company, Ltd., state that with the installation of the Alfred Herbert All-Electric Drilling Machine, "the production times on all jobs have been reduced by 20 per cent and quite often 30 per cent, and in certain cases, where the combination of spindles just suits the particular job, by as much as 50 per cent and over".

Just as machines have greatly improved, so have the cutting tools. The famous high-speed steel, which thirty years ago hoisted the carbon tool

from the engineer's tool chest, is now having its position challenged by the Tungsten carbide tool. This is a tool made in the laboratory, and is very expensive. It has little tensile and so is not suitable for all jobs. But it is very hard, and its cutting edge will stand for a long time, in comparison to other steels. A small piece is welded on to a bar of cheap steel, and so is called a tipped tool. With this tool it is possible to work at very high speeds. In a lecture to the Institute of Production Engineers, the speaker quoted a case of labour saving with this carbide steel. When he machined a cast-iron bracket with high-speed steel, it cost 2s. 9d., but when he machined a similar cast-iron bracket with tungsten tools, it cost only 2s. 1½d. When he used tungsten tools for machining stainless steel, his cutting speeds were 80 to 100 feet a minute; he could only operate high-speed tools at 30 to 40 feet per minute on the same steel. An Alfred Herbert all-electric capstan lathe, equipped with "Ardoloy" Tipped Tools, is capable of taking a cut from $\frac{1}{16}$ inch to $\frac{1}{8}$ inch deep at a rate of 2,100 feet per minute.

I have tried to show the development of machinery these last twenty years. Naturally, these developments have forced changes in the position of the operator. At one time the piece rate was based on the speed at which the worker operated the machine. In other words, the worker set the pace. For the last ten years, the employers have been trying to change that method. They are trying to make the machine set the pace; and the

worker must keep up with it. The old method of piecework was to time a man on how long he spent on a job and then fix a piecework price on that time. The man who timed the job would make allowances, for belt breakages, squicking line shafts, waiting for work, and such things as would prevent an operator from earning his money. There are also men who have great ability in operating machines. They plan their work. They keep a good stock of tools and keep the machine in good order. These men may earn anything from time-and-a-quarter to time-and-a-half or even a little more. In most cases we might say that all men have what the economists call a rent of ability, which varies according to different workers.

These last ten years the employers have spent much of their time in trying to devise schemes of piecework whereby this rent of ability might be filched from the workers. They have tried all kinds of bonus schemes, where they give a worker so much time in which to do a piece of work. If the worker accomplishes the job under the estimated time, then he is given a portion of the time saved. But in many cases the time allotted is not sufficient and the job takes longer than the stated time. Here the operator has worked at a piecework rate for a daywork wage. The fixing of piecework prices was taken a step further when the rate fixer was introduced. This is usually a workman who is slick at operating most kinds of machines. For a good daywork wage he is given the job of fixing wages for his fellow-workers.

He would go on to the machine and operate it, then fix a price. This was not so bad, for there is much in the saying that "what one person can do, another can also do". You could discuss with him and argue the price.

From these simple methods of fixing piecework prices the employers are adopting a more complex one. They employ an "efficiency expert". He attempts to arrive at a piecework price by a series of mathematical calculations. He looks for a workman who is quick at operating the machine. He stands by this workman for hours and sometimes days, taking down the times at which the worker does each operation. He will take down the time of the same operation a good number of times. Neither the worker nor the machine is perfect. The worker might have a bad cold, or his lunch might have been a little too heavy, or the shop might be too cold or too hot; these items will affect the times at which he does each operation. Or, as regards the machine, the belt might break, it may want oiling, in which case you must wait for the "oiler round"; you may be held up a few minutes waiting for a fitter to adjust some part of the machine. These mishaps, whether they affect the man or the machine, are a cause of lost time. This is the reason why the expert stands about for a long time. He wants to get a time when both the worker and machine are free from mishaps. When he gets the fastest time then he fixes the piecework price. The worker finds it difficult to keep up this speed for eight hours and so begins to lose time. The

worker does much more work than he did previously, but he derives no benefit because his prices have been reduced. In fact, his wages under these new systems are lower. Naturally, he is annoyed, he loses his temper, and the continual rush makes him a nervous wreck.

At one time, the stress was on good machinery, now it is on both machinery and the workers. The employers have realized that just as a machine can be made to work faster, so can a worker. Another "speeding up" invention is the conveyor belt.

When this starts, the worker must keep pace with it. If he does not, then it means that his fellow-workers are waiting for him. This not only makes him feel inferior, but he begins to be afraid that he might be dismissed for being too slow. Dr. Gerd Fabian, in his book, *Social Aspects of Rationalization*, talks about "an external compulsion which forces the worker to complete the tasks which are constantly and automatically brought in front of him; a social compulsion resulting from the fact that the worker feels himself to be a link in a chain and to some extent responsible for his comrades' work". Dr. Gerd Fabian sums the whole position up when he writes about "*external compulsion* which *forces* the worker". The worker objects to being forced along. He dislikes the idea of the efficiency expert always parading at the back of him. He sees in the efficiency expert the shadow of the "slave driver". In place of a whip he threatens you with the sack. The worker sees

how much more work he is doing, yet his wages are less.

In one factory where this system was introduced, girls were building wireless sets. Before the introduction of the system they built 36 valve grids per hour on a flat rate, 31s.; and they had to inspect 42 per hour for a bonus of 10s. When the Bedaux System was introduced, they had to build 155 grids per hour for a flat rate of 31s., and to earn a bonus of 6s. 6d. they had to inspect 200 per hour. They had to be in position on the conveyor belt three minutes before time. One efficiency expert whom I watched timing a man told the operator that he ought to be earning 1s. 3d. per hour. This man was a conscientious worker and was entitled to book 1s. 3d. an hour, but owing to the machines being old he could only book 1s. But the "expert" would persist in asking him why he was not booking 1s. 3d. per hour. This badgering by the expert makes many men nervous. Seeing the expert at the back of him every five minutes gets the man's back up and he either tells the expert in unprintable language to move off or he himself leaves the machine. The expert then threatens him with the sack. Then there are deputations in the office, but as the employers favour the expert, the workman gets no satisfaction. The workman then asserts his individuality and goes on strike. I know of one instance where, as soon as the expert started in the shop, the workers showed their opposition. There were only about 30 per cent in the Union, but before many weeks the Union membership

had risen to 90 per cent. The membership of the Amalgamated Engineering Union is steadily rising, and it is this fear that the wages are going to be reduced that is causing it. In my own Union branch the membership has risen from 150 to 200 this year. These last three years numerous strikes have taken place against this speeding up. In July, 1934, there were 450 on strike and in September nearly 500 on strike against the Bedaux System.

The introduction of new machinery and new methods of organization in the engineering trade has caused great reductions in labour costs. The output per worker between 1924 and 1929 increased 24 per cent. The Leyland Motors, by use of German high-speed steel, increased their output from 50 to 80 chassis a week; without increasing the number of men. With the aid of the automatic machines, and due to the product being standard, the motor-car industry has made some startling improvements. A Mr. H. C. Armitage, an efficiency engineer, says that an engine bearing bolt took 116 minutes to make in 1880, but with modern methods it now only takes 8 minutes.

Although the volume of work has increased since the War, there is no proportionate increase among the workers employed. In fact, as the volume increases, the number of workers decreases. The tradesman has not only to compete with machinery, but he has to meet the competition of boys and girls. As the machines become more simple to operate, girls and boys are put on them.

The twist drill trade to-day is 75 per cent boys and girls. We who are working in the shop can see how month by month the girls are encroaching on the position of the men. To-day the inspection benches are full of girls, and I might say they do their work very well. But what must be remembered is that what is a good wage to them would be an exceptionally poor wage for a man. In 1924 there were 38,700 girls employed in the engineering industry. By 1933, this number has increased to 41,670, while the total number of men in this period has decreased.

The apprenticeship problem is another case where girls affect the employment of boys. The jobs which are done by girls used to provide employment for youths. A boy just leaving school is too young to work an automatic lathe, and I think employers find it difficult to know how to exploit the boy between 14 and 17 years of age. Of course, the way they get over it is by not employing so many as they would if girls were not employed. A trade union organizer told me that he had just been in touch with a firm that had not had any apprentices for nine years. I think we could find this to be true in many other cases. In the shop where I work there are no indentured apprentices. There are some lads who work in the shop, but they are only on production jobs, and so are not taught the trade. Numerous lads now work until they are 21; but because they have not learnt the trade properly they either go labouring or on to a semi-skilled job, which, in many cases, is not much better than labouring.

The firm will not pay them the full rate, and they have not the ability or the power to "bluff" their way through.

When we look at the unemployment problem, we see the engineering industry has been hit very badly. In 1913 only 2·4 per cent of the members were unemployed. But by 1926 this had increased to 12·58 per cent, by 1930 to 19·05 per cent, by 1932 to 24·25 per cent. In 1933 it decreased to 16·03 per cent. The wages now of roughly £3 per week for the skilled, and in numerous cases much less for the semi-skilled workers, do not give one much chance to save for a "rainy day". The old craftsmen used to say that "he was a poor engineer who couldn't rattle two bits of gold together before the War". When a man becomes unemployed to-day, he sometimes stops out for long periods. The worse thing about this is that the man loses confidence. He is afraid his skill might have left him. This is not true, because as soon as a man gets to work again it appears to come quite easily again. But he finds it difficult to gain confidence. Also, the poor food on which he has lived undermines his constitution, with the result that when he does get a job he is all flustered.

There was one man who worked near me, and he had been out of work. The first week he started, a steel turning stuck to his overalls, on which he caught his hand. His hand was all covered in blood. It was not much more than a scratch, but it looked bad. The next week the same man slightly trapped his finger. This was

half an hour before finishing time. On each occasion he fainted. When I went to take him home, he was all "trembling", and he said, he hoped they wouldn't give him "the sack". The man did really look bad, and I felt sorry for him. But the man was not dismissed, and the last time I saw him he looked quite well and had not had any accidents. Other men get what we sometimes call "shop lost". By this we mean that when they come into a new shop, they do not know where to look for tools, and in many cases they are afraid to ask the workers around them. The result is that they do not do their work in scheduled time, and so are stopped. These men would be quite all right if they had time to look about them.

In the foregoing pages I have tried to describe the position of the engineering worker; how, by the development of science, he has been reduced from the aristocrat of industry to a level which is not commensurate with his skill; while, on the other hand, the companies which are employing him are making huge profits. The position facing him is not a "rosy one", for the trend of development is to create more unemployment, and the chance of increasing his wages because of the scarcity of engineers does not appear possible.

Rationalization has caused hundreds to be unemployed. Around Sheffield this has been particularly great. At Grimesthorpe 100 men were dismissed, 1,000 at Cyclops Forging Department, 671 at Penistone, and 600 at Openshaw, Manchester. These factories have been closed and

will not open again. These men must find fresh situations.

Then the efficiency experts say a man must work so fast, and gather so much ability and speed, that it will be impossible for a man out of the street to come and do his job without being shown. The old engineer would walk into a shop and do a job straight away. But under the present method it takes time to get up to the speed of other workers. This means that rather than employ new men, a firm will work its present staff overtime. This is a great tax on the worker's physique, because he must do the required amount per hour. The worker dare not refuse overtime, first because he might get the sack, and second because his wages are poor and he sees a good chance to supplement them with a little extra. This last summer, I have worked a great deal of overtime, sometimes from 7.30 o'clock in the morning to 9 o'clock in the evening. I spoke to a man last week and he told me that he had not had more than three Sundays at home this year. All the others he had worked. This seems ridiculous in a town like Sheffield where thousands of skilled men are walking the streets.

The Amalgamated Engineering Union have tried to remedy this by suggesting a 40-hour week. The trade union leaders and some employers see no hope of the industry absorbing any more workers unless there is a reduction of hours. The *Statist*, on 21st June, 1930, proved that "the increase in productivity of each worker has gone hand-in-hand with an increase in the number of

98 THOSE WHOM THE MACHINE CONTROLS
unemployed ". To me it seems ridiculous to
make a " god " of " speed and efficiency ". I do
not see any point in putting half the population
out of work and making them " human derelicts ".
The end of all industry should be not the perfect-
ing of material objects, but the creating of human
happiness for the people. This has yet to be
accomplished in the Engineering Industry.

THE COTTON OPERATIVE

By JIM WARD

WHEN cotton first came to England, its manufacture was grafted on to the already existing woollen industry, but by degrees it became centred in Lancashire. Its development afforded ample scope for inventive genius, and during the latter half of the eighteenth century and early nineteenth century, Robert Kay and Dr. Cartwright transformed the weaving and James Hargreaves, Richard Arkwright, and Samuel Crompton the spinning section of the industry.

These inventions, aided by James Watt's steam-engine, led the way in that mechanical revolution which was to make Britain pre-eminent. From leisurely workers in the home these people who spun and wove became the "factory hands" of an increasingly prosperous industry clamouring for more and more toilers.

This rapid growth of the cotton trade brought many evils, not the least being its employment of child labour. Large numbers of pauper children were brought from the poor houses of London and the South, many of them being only six or seven years of age. They toiled fourteen or fifteen hours daily, Saturdays included. The most heartless and cruel methods were adopted to

keep these children at their tasks, frequent dip-pings overhead in a tub of cold water serving to reviv  those who fell exhausted at their work. In spite of the efforts of such humane reformers as Robert Owens, child labour continued. (It was claimed that unless the fingers were trained in childhood, to become a skilled cotton operative was impossible.)

Many people in Lancashire to-day can tell of their work in the mills at 7 years of age. Later, the common practice was to be "half-timer" at eleven and "full-timer" at 13 years of age. Thus were mental and physical growth retarded with a result noticeable to-day in the smaller stature of so many of Lancashire's people.

The earning of wages, however, contributed to an early sense of independence and thrift, and was in large measure responsible for the habit of early marriage and the setting up of separate households.

As the output of cotton goods increased more and more mills were built and a great export trade was created which was to continue for more than a hundred years, adding much wealth to the Empire. To house the rapidly increasing population, long rows of small four-roomed houses of red brick were erected in close proximity to the factory. No space was wasted and considerations of planning and lay-out were non-existent. Hence although the "cotton towns" assumed size and importance they were devoid of beauty, a mean congestion only resulting from the attempts to house the workers as near to their work as possible.

This limitation of area made possible the "knocker up", who, by 5 a.m., winter and summer, began his round, tapping on the bedroom windows of his clients with umbrella wires attached to a long pole. Soon the clatter of clogs would resound on the flagstones as adults, young persons and children hurried towards the lighted mills to the accompaniment of numerous "buzzers". By six o'clock the streets were again empty—except perhaps for a belated operative—a mother who had carried her young child out to nurse before commencing her 10-hour day at the looms.

Five-thirty in the evening saw the workers returning homeward. The family tea must be prepared and consumed, the necessary housework attended to, baby must be brought home, food must be prepared for next-day's meal in the mill. Small wonder that the menfolk must share in these duties since all share in the wage-earning.

Lancashire's "Friday night"—an institution and a joke in many parts of the country—was "cleaning night". The flagged floors, slabs of stone, were scrubbed and sometimes sanded, fire-side appointments were blackleaded and polished and, in a manner almost exclusive to the county, the "fronts" were swilled and swabbed, the doorsteps and window-sills whitened or yellowed with special stones for the purpose. The reputation for cleanliness which the housewives of Lancashire enjoy has probably resulted from their never-ending struggle to combat the grime from

a soot-laden atmosphere to which hundreds of factory chimneys contributed. They lived in the area and escape was impossible. Saturday afternoon football for the men and shopping, with a visit to the open market, for the women gave place to Sunday with its church worship and Sunday school. So, with a few hours' respite, the round commenced again.

Protest against conditions had brought into being the Trade Unions. These became stronger, Factory Acts were passed for improvement and regulation of labour, and Lancashire quickly became the greatest industrial centre in the world.

"Equal pay for equal work" has long obtained in the cotton trade. Piecework is at rates according to the uniform lists agreed to by the Trade Unions and Masters' Associations. Though individual earnings were small, the family total, which was frequently pooled (each member receiving pocket money), often amounted to several pounds per week. After "paying their way", some portion was put on one side for a "rainy day" or for holidays and perhaps towards future house purchase.

Lancashire mill workers, though open handed and ready to help when distress calls, are practical and thrifty, and not a few saved enough to ensure comfort in old age. Now and again, workers with plenty of initiative began manufacturing "on their own" by using their own and relatives' money or joining with others in mutual enterprise. Some of the best and most prosperous employers started in this way.

In the spinning section though, the much larger capital outlay required usually prohibited such ventures, and resulted in this department of the industry remaining in the hands of companies. While some few firms embraced all sections of the trade from raw cotton to marketing, and thereby made fortunes, specialization of each process is the general rule. This specialization, carried on for generations, has left its mark on whole towns and their inhabitants. There are distinct differences in physique and outlook between the weavers of Blackburn or Burnley and the spinners of Oldham or Bolton. These differences, though not obvious to the stranger, are nevertheless discernible to the Lancastrian. The various levels of income have not been without effect, for the weaver with his 25s. in pre-War days came well below the standard of life of the spinner with 50s., or the cotton salesman with £5. The sectionalizing of the industry brought about local concerns and points of view. Thus Liverpool is mainly concerned with imports and exports—raw cotton and finished goods ; Manchester is the centre where merchants and manufacturers meet to do business ; while places like Bolton, Blackburn and Burnley are the scene of the actual work of making raw cotton into cloth. Hence the well-known phrase—Liverpool gentlemen, Manchester men and Bolton chaps !

The skill of the cotton worker is proverbial. Manipulation of soft slender threads demands a delicacy of touch only acquired in early life ; rarely does anyone learn to spin or weave success-

fully unless this early training is received. Deftness of hand and quickness of eye are essential in keeping up with the machines, for output in quantity and quality is the urgent consideration of employer and employee. Profit and wages depend on output. These long years of training required for proficiency in spinning or weaving almost invariably mean that the operative keeps to his particular section of the industry. The jobs are so different that there is rarely any passing over from one to the other.

Most of the successful manufacturers have gone "through the mill" to the extent of learning the processes involved, and have frequently trained their sons in like fashion.

Inventive genius has always been evident in the cotton trade, but, with few exceptions, the inventors, as is so often the case, have failed to benefit by their creations. Not only have Lancashire men built up this great industry but they are constantly embodying new ideas in machines and methods; most parts of the County Palatine have some local genius who has contributed to textile efficiency.

An asset in cotton manufacturing for which no one can take credit is the atmospheric humidity of Lancashire. It is well known that damp yarn is stronger and more easily withstands the strain of weaving than does dry material. Humidity is artificially increased in the sheds for this purpose. Though the moisture is good for the yarn it is bad for the operative; the atmosphere of most cotton mills is so enervating that it does not

fail to have effect on those who spend years of close speedy application in its midst.

Modern textile chemistry has long ago discovered how to weave cotton successfully without this moisture, but it is cheaper to permeate the air with vapour than to use expensive sizing ingredients when preparing the yarn.

Women seem to withstand the wear and tear of mill life better than do men, but all acquire the pallid steamed look so conspicuous on the faces of cotton workers. Children entering the mill soon lose their rosy cheeks and the spring goes from their step as they stand, day after day, for long hours, on the wet floors which make necessary the hard wooden-soled clogs. Holidays allow that healthy colour to steal back again, but in times gone by these were brief and few. Much agitation by the Trade Unions has improved the position, but even now a full week in summer marks the extent of holidays when trade is normal. At present, of course, unemployment, whole or partial, brings enforced periods of idleness. It was a matter of surprise to the uninitiated, how much enjoyment—and expenditure—could be packed into one week at Blackpool or the Isle of Man by those whose only outlet this was after fifty-one weeks of arduous toil. Preparation is made long in advance; holiday clubs abound in Lancashire; sums from a few pence to a few shillings are paid in weekly, and on the eve of the “wakes” thousands of pounds are distributed. In latter years there has not been the same reckless spending as formerly, when to squander £20 on

a week's holiday was far from uncommon. Reduced circumstances, combined with better judgment and more varied interests, have led to people seeking wider avenues of pleasure and recreation. The advent of the motor-coach, with its scheduled tours, has brought Scotland, Ireland and the South Coast within the realm of the week's vacation. Again, though the Press publish the huge totals paid out by the savings clubs at holiday times, there is no mention of the amounts which are returned again for renewals of clothing, household gear, etc.

The independent outlook and forcible expressions of cotton people are known far afield. The independence of the wage-earner is noticeable among young people, but family ties are by no means weak, and when parents are needy or are unable to work, their right to support and shelter is never questioned.

Large families are not so much in evidence as formerly when numerous children, going early into the mill, were regarded as an investment by unscrupulous parents. In hard times (and Lancashire knows them well) to get enough food was difficult and the growing children were half-starved. (My own grandfather recalled how in the Cotton Famine of 1864 he ate porridge only, twenty-one times a week.) With the rapidly increasing population and its intense concentration on making money out of cotton, Lancashire ceased to be able to feed itself, and when strikes and lock-outs occurred suffering was acute. It was not possible for the workers to supplement the family

table by their own food production. They were totally divorced from the land, even if they could have gained access to it, and all knowledge of food cultivation was lost. Therefore, when the trade cycles brought good or bad times, the workers were either in the midst of poverty or plenty.

But steadily, over the years, wealth increased and social and educational facilities were developed. Manchester and Liverpool led the way for other towns to follow. Technical schools and other places of learning were opened for the teaching of the theory and practice of textile manufacture to the workers. Most of the teachers in these subjects were men who had started life in the mill and by long and hard study in the evening classes won their way to higher positions. Out of the Technical Colleges graduated many experts, some to take up positions of responsibility in the industry at home, others going to mills in other countries overseas, or to found schools of instruction there. At all times, students from other lands have been freely admitted to the technical colleges of the county and after the finest tuition, have returned to make cotton goods at home. Thus Lancashire taught the world the mass production of cotton cloth, and many countries which were formerly our customers are now our competitors.

The making of machinery to supply the demand both at home and abroad, has developed a large and important subsidiary industry with clever technicians ever seeking to improve their

output. Perhaps this very development of the textile machinery industry has handicapped the position of the Lancashire operative. The scrapping of obsolete machinery and mills has never been popular. Manufacturers have, year after year, been content to rely on the skill of the highly efficient weaver or spinner whilst working on looms which were nearly a hundred years old. The foreign competitor has thus reaped the benefit of more up-to-date machinery. This refusal or inability to take advantage of new methods, both of production and organization, has contributed in some measure to the present state of the cotton trade in this country.

Tariffs, boycotts and Japanese competition, coupled with restricted world trade, have had a crippling effect and many firms as well as their "hands" began to feel the strain.

The spirit of individualism has ever been strong in cotton circles and the doctrine was the *laissez-faire* of the Manchester School of Economics. With declining trade competition became very fierce and firms with poor reserves soon went to the wall; old-established firms, particularly those which had been making the same kind of cloth for generations, had to wind up. Many of the concerns, floated during the boom at inflated prices, called in their unpaid capital and many small investors were thus made bankrupt. In the spinning section, loan capital bearing low rates of interest was taken up as an investment by operatives themselves. In many instances these have paid no interest for years and often the capital

value has dwindled through the mills being recapitalized on a lower basis.

In an effort to keep the mills running, numerous experiments have been made, but the favourite method has been the cutting down of wages again and again. At present, little more than half as much is being earned as during the boom, so that those working are often little better off financially than their unemployed companions.

Another method has been to increase the number of looms per weaver, so that the traditional 4 became 5, 6 or 8 according to the sort of cloth woven. This, without alteration of wages, was a hardship which some employers, to their credit, refused to inflict, but the more unscrupulous have forced the issue and insisted, compelling the workers to acquiesce by using the unemployed to break their resistance. Again, not a few hard-pressed employers persuaded their workers to put money in the firm so that the mills might continue running. £10 was the average sum paid to keep the job. Often both job and money were lost. The Trade Unions tried to prevent this exploitation, but the urgent necessity to keep in work was too pressing to be overcome.

The internal competition resulting from the domination of individualism enabled cloth merchants to pit manufacturers against each other in the quest for business, and often orders were executed at prices far below the cost of production. Attempts to enforce uniformity of action and of rates of pay have met with a measure of success, but very much more must be done if

final disintegration is to be averted. Much of the former trade is not likely to be regained, for other countries are making much of their own cloth and also exporting their surplus. With the leaders of the industry lies the responsibility of eliminating wasteful competition and by methods of mutual co-operation bringing the organization of the trade on to a sound basis. Improvement is then possible if all sections pull together and adapt themselves to modern conditions.

The past ten years have been disastrous for Lancashire. Unfortunately, some of the most considerate employers have been the hardest hit. In an effort to keep going and find employment for their "hands", many of whom have worked thirty and forty years for the same "boss", many esteemed firms have gone down. Their mills, which, a decade ago, would have realized a fortune, now stand derelict, with the machinery sold for scrap.

Thousands of highly skilled operatives walk the streets, vainly looking for work. Their clothes grow shabbier as the weeks slip into months and the months into years. In many cases the small savings of a lifetime are gone and the homes in which they had so much pride are mortgaged beyond redemption. It is difficult to visualize how these hundreds of thousands of unemployed operatives can ever again be absorbed into their old industry. The "more looms per weaver" system will reduce the number of workers required still further, especially when the now perfected automatic loom is extensively adopted, as it must

be. Perhaps a scheme for sharing the existing work might be evolved with the reduced wages supplemented from other sources.

Already far-seeing people realize that the best way for these surplus workers of industry to become self-supporting again is to turn their attention to the production of foodstuffs and the cultivation of the soil. Urbanized as they are, there are many difficulties to be overcome, a new skill and a new outlook to be acquired. That this can be done is already being proved, for men have taken over plots of land and worked them. Tuition in keeping livestock is available and as experience is gained, small holdings have been taken over. To men "born and bred to the cotton trade" this is indeed a new way of life, but demonstrably, not an impossible one.

For thousands of years man pleasantly combined spinning and weaving with farming. Barely two centuries of mechanized industry have intervened, with much hardship and poverty to the workers.

One wonders if a renewal of the old happy combination, accomplished by some form of decentralization of the staple industry, might not bring back some measure of happiness and prosperity to Lancashire.

PART III
OBSERVERS

MAN AND THE MACHINE

By SIR ARNOLD WILSON, K.C.I.E., C.S.I., C.M.G.,
D.S.O., M.P.

I HAVE spent twenty years in the Middle East, and have, during that time, seen two countries—Persia and Mesopotamia—introduced, for the first time, to machines in the shape of aeroplanes, motor-cars and lorries, railways, tractors, oil pipe lines, and, in Persia, to factories for the manufacture on the spot of textiles, sugar, and other commodities formerly imported. My first journeys, from 1907 onwards, were on foot or on horseback; my first messages by trained and hereditary runners. The telephone was unknown—the telegraph had been introduced in the memory of men of middle age. My last journeys were by air and rail and car—my latest messages by radio.

I have studied with keen interest every phase of this apparent collision of cultures—the impact of Western technique upon one of the most ancient and continuous civilizations that the world has ever known. The immediate and direct results have been political and social rather than economic. The power of the Central Government has increased, and with it that of executive officials professionally committed to nationalistic policies and ideas. Troops can be sent to any spot in a few

days, high officials from the capital can reach any centre in a few hours. The older traditional cultures, with their roots in the soil and climate of regions differing from each other as much as any part of Northern from Southern Europe, are being overlaid and obliterated by a new culture, a synthesis of Eastern and Western ideas.

Eastern nations in general have identified West European political institutions with progress, and progress with improved methods of communication and transport. Finding themselves menaced by the increased strength of the West, they have recklessly adopted Western political systems, so earnestly pressed upon them by well-meaning diplomats. They have spared no pains and have shrunk from no sacrifice to make themselves masters of the technique of speed. Realizing their dependence on the West for manufactured goods, they have successfully initiated a policy of industrialization. Persia, Turkey and Iraq formerly sent to Europe raw materials and food-stuffs in bulk, and a relatively small quantity of exceedingly fine hand-made carpets and silks, fashioned with a skill and with a genius for colour and pattern which had no counterpart in the West. They are now exporting far smaller quantities of raw materials and importing fewer manufactured articles.

Indigenous raw materials are being increasingly used in local factories. The change, made possible by very high protective tariffs, has raised internal prices and has entailed much hardship, but it has increased the variety of employment,

particularly in skilled occupations, and has reduced the dependence of these countries on the uncertainties of foreign markets and the vagaries of exchange. These changes have been made without foreign loans out of the proceeds of taxation.

The economic results have been, on balance, good. Costly mistakes have been made, as is inevitable, but men whom I knew, in their youth, as nomad shepherds and tillers of the soil have become competent fitters, reliable lorry-drivers and good factory hands, and are, on balance, freer, and not less healthy.

The advent of motor-cars and lorries has driven the great caravans of camels, mules, pack-horses and donkeys off the main roads ; those who made a living by breeding transport animals and by working as muleteers and camel men have been displaced by a larger number of lorry-drivers and garage hands. Imports of cars, machinery and tyres (petrol is produced in Iraq and Persia by refiners employing mainly local labour) have increased—imports of textiles and of many other articles now made on the spot have fallen. Employment, on balance, has increased, is more regular and, because more diversified, on the whole more congenial. Famine was formerly recurrent because crops could not be moved from one province to another except at great cost ; motors and railways have exorcized this spectre. Whether human happiness has increased, we cannot say ; there is no absolute standard of comparison.

The standard of living, though it has altered, is not higher—tea, sugar and coffee, those much-prized luxuries, were never so dear in the last half of the nineteenth century as they are now, thanks to revenue duties and the need to regulate the balance of trade, and good clothes are dearer, but, in general, the people accept, actively or passively, the claim of their leaders that economic independence and self-sufficiency are objects which justify great sacrifices.

The broad outlines of the picture drawn above are generally applicable to most of the countries of the world which were, until recently, predominantly or almost exclusively agricultural. Mechanization in these countries is still in its infancy. It is not an indigenous movement, but follows in the wake of Western tendencies, as a consequence of the adoption of Western inventions and the importation of Western machines. It has, by a strange paradox, tended to estrange rather than to unite Europe and Asia.

Not for a century have there been so few foreigners on the road, whether on business or pleasure—not for a century have so many restrictions on movement been enforced. Islam knew no racial boundaries in time of peace and the pilgrimage was a very important factor in spreading understanding among the very poor of the thoughts and ways of other Eastern nations. It is now far less popular, and though, thanks to mechanization, it was never easier, it is no cheaper.

From the point of view of countries not at

present industrialized, therefore, mechanization appears, on balance, to be beneficent—it is quite certain that the cult of the spinning-wheel will have no followers outside India, nor even in India for long. We may regret the disappearance of rural industries, and of the highly skilled craftsmanship which we associate with the centuries before the machine arose, but we cannot ignore the greater material comforts that it has brought and is bringing to the mass of mankind. Nor should we fail to take into account the inward satisfaction which, in my experience, men feel who handle, tend, and use machinery after an early life with nothing more mechanical to aid them than perhaps a rifle and a pair of shears. The machine is not to them bondage, but release from bondage.

Mechanization in industrialized and partly industrialized countries bears a different and, at first sight, a more sinister aspect. The increasing use during the past hundred years of steam and electric power, and of machines, is having effects upon those nations mainly concerned analogous in some respects to the effects of slavery—that Nemesis of Nations. It has resulted in cheap imports of articles that could formerly be produced locally with difficulty, or not at all. It is not a new but a constant factor to which we have to adjust the mechanism of our civilization. In the year 1835, shortly after the introduction of the machine, the Viceroy of India (Lord Auckland) wrote—"The misery is scarce paralleled in the history of trade. The bones of cotton weavers

whiten the plains of India." That was, on a larger scale, a repetition of the hardship caused everywhere by the *sudden* introduction of mechanical means of production. The indirect effects, which affect all subsequent generations, include the change of status from that of independent craftsmen or agriculturists, living for the most part in small towns or villages, to that of weekly wage-earners, herded in cities, and divorced from the land. They are no doubt better fed and better clothed, and they enjoy perhaps greater personal freedom—freedom to change their occupations—freedom to abandon that of their father and to improve their own status. They have lost something in the change, but I am not satisfied that, on balance, there has been a loss to the community. "Say not thou, what is the cause, that the former days were better than these—for that were no wise question."¹ Only when we have learned to recognize the essential features of the past at work everywhere in our own age, shall we be able to handle wisely our present problems. I much doubt whether there is anything fundamentally new in our economic position to-day, however much it may differ in appearance, from conditions in former times. The change from trade by barter to trade by means of money and bills of exchange, the effect of the Enclosure Acts, and the change from road to rail, were as revolutionary in their day as any changes that have since occurred.

"In this refined period," wrote the Reverend

¹ Ecclesiastes vii. 10.

John Brown of Newcastle-on-Tyne, in 1758,¹ "additional Art and Experience in Labour prevent in some measure the increase of numbers employed. By the invention of machines and equal degree of tillage and trade can be carried on by fewer hands." Never was a prophecy more completely disproved by events.

"Man," wrote Disraeli² nearly a century ago, "was once an Artisan : at the best he now watches only machines, and even that occupation slips from his grasp to the woman and child. . . . If a Society that has been created by labour suddenly becomes independent of it, that society is bound to maintain the race whose only property is labour, out of the proceeds of that other property which has not ceased to be productive."

Yet, who can deny that the modern factory worker is more skilled, as well as healthier and happier than his forbears ?

The Industrial Revolution was, on balance, a boon to men : it raised the standards of life and conduct everywhere. The upper classes a century ago accepted habitual discomforts against which the poorest in our day would rebel. The poorest lived and died in conditions which exist to-day only in Russia and Eastern Europe. The Napoleonic wars, involving a vast expenditure of labour and treasure, hampered our statesmen in their efforts to adjust the national life to new

¹ *Estimate of the Manners and Principles of the Times*, 7th Edition, 1758—quoted by Burke in *Letters on a Regicidal Peace*.

² *Sybil*, Chap. XIII, 1845 (The Weaver Speaks).

developments in the first decades of the nineteenth century even more than the aftermath of the war of 1914-18 affects us to-day.

Mechanization was more violent in its first effects than in its later developments: we had, at first, no technique to mitigate its effects: we have since evolved, in this country, a system of mutual insurance against extreme distress which is the envy of the world. Let us not rest content with what we have done, but let us not fall into the greater error of under-stating past achievements, and thus be led to supine despair.

Mechanization, like other changes, makes it necessary for men and women to adapt themselves and the structure of society at large to new conditions by taking up the alternative employments and utilizing to the full the new opportunities which new processes afford. Serious dislocation only occurs when the process of mechanization proceeds too quickly. The following tables from the 1931 Census show how fast the people of these islands have in fact adapted themselves to post-war conditions.

Thus in ten years, unaided to any substantial extent by tariffs, and notwithstanding the effect of the Unemployment Insurance Acts and of Trades Union Rules in discouraging insured persons from changing their occupation, some 790,000 ¹ men have, on paper, left certain industries, of whom probably half a million have entered others, the balance being accounted for by death and retirement. The total figures for

¹ Figure from decrease column.

Occupations. MALES ONLY.	1921.	1931.	Ratio per Thou- sand of 1931 to 1921. Occu- pations.	Increase.	De- crease.
1. Fishermen	28,808	26,945	935	—	1,863
2. Agriculture	1,171,298	1,116,573	953	—	54,725
3. Mining and Quarrying.	1,061,749	966,210	910	—	95,539
4. Workers in non-Metal- liferous Mining Pro- ducts	19,385	23,242	1,199	3,857	—
5. Bricks, Pottery and Glass	62,151	72,076	1,160	9,925	—
6. Chemical Processes . .	28,656	39,596	1,382	10,940	—
7. Metal Workers	1,408,933	1,349,774	958	—	59,159
8. Metal Workers (Precious Metals)	28,751	23,321	811	—	5,430
9. Electrical Apparatus . .	128,558	186,134	1,471	59,576	—
10. Watchers and Scientific Inst.	23,829	20,771	869	—	3,058
11. Leather	50,153	46,841	934	—	3,312
12. Textile Workers	305,938	301,552	986	—	4,386
13. Textile Goods, etc., Makers, and Dresses.	276,161	276,738	1,002	577	—
14. Food, Drink and To- bacco	150,000	167,989	1,120	17,989	—
15. Goods and Furniture . .	443,352	500,632	1,129	57,280	—
16. Paper, Cardboard, Book- binders	30,600	37,427	1,223	6,827	—
17. Printers and Photogra- phers	126,592	152,288	1,203	25,696	—
18. Builders, Bricklayers, Stone and Slate Con- tractors	503,535	692,123	1,375	188,588	—
19. Painters and Decorators	212,592	261,145	1,228	48,553	—
20. Workers in other Ma- terials	27,156	29,666	1,092	2,510	—
21. Workers in Mixed or Undefined Materials	78,316	66,836	853	—	11,480
22. Transport and Com- munication	1,420,593	1,565,846	1,102	145,253	—
23. Commercial, Finance Insec.	1,067,404	1,466,587	1,374	399,183	—
24. Public, Administration and Defence	442,325	290,202	656	—	152,123
25. Professional Occupations	269,359	356,726	1,324	87,367	—
26. Entertainments and Sports	63,021	91,654	1,454	28,633	—
27. Personal Service (Clubs), etc.	339,944	462,935	1,362	122,991	—
28. Clerks, Draughtsmen, Typists	568,305	795,486	1,400	227,181	—
29. Warehousemen, Store- keepers and Packers.	222,269	254,963	1,147	32,694	—
30. Stationary Engine Driv- ers. — Dynamo and Motor Attendants	156,281	157,107	1,005	826	—
31. Other and Undefined Workers	1,304,755	1,448,008	1,110	143,253	—
32. Retired or not gain- fully occupied	1,788,390	1,385,526	775	—	402,864
TOTALS : Males	13,807,159	14,632,919	35,482	1,619,699	793,939
„ Females	15,728,330	16,410,894	32,043	851,229	128,665*

* The figures show a decrease of females employed on agriculture of 27,000. In all other industries the decrease, if any, is negligible, the increase usually large

females show that there has been a decrease in certain industries of female employment aggregating 128,000, and an increase of 850,000.

Those industries in which the greatest expansion of employment has occurred are :—

4, Workers in the treatment of non-metalliferous mine and quarry products, e.g. makers of coal gas, coke and by-products, kilnmen and lime burners. 5, Makers of brick, pottery and glass. 6, Workers in chemical processes. 9, Electrical Apparatus. 14, Food and Drink and Tobacco. 15, Wood and Furniture. 16, Paper and Card-board. 17, Printers and Photographers. 18, Builders. 19, Painters and Decorators. 22, Transport and Communication. 23, Commerce. 24, Professional Occupations. 26, Amusements. 27, Personal Service. 28, Clerks and Draughtsmen. 29, Warehousemen.

Of these occupations, those which show the greatest numerical increase of employment are precisely those in which mechanization and rationalization have made the greatest strides, viz. :—

9, Electrical Apparatus Manufacturers. 15 and 17, Wood, Furniture, Paper and Printing. 18 and 19, Building and Decorating. 23 and 25, Commercial and Professional Occupations. 26, Amusements.

On the other hand, the industries which are employing fewer men are those least susceptible

to mechanization, e.g. coal-mining, railways and agriculture.

These are also, in general, occupations in which juvenile labour (under 18) is at a minimum and, except the first-named group, the amount of female labour employed has not increased in the same proportion, though there is a large increase (over 15,000) in female labour in Nos. 9, 12, 23, 25, 27, 28, 29, and 32. They are, moreover, occupations in which, in general, unemployment was least in 1931. In one industry only, and that unmechanized (workers in skins and leather), has there been a reduction in male and an increase in female labour as compared with 1921.

These figures go to confirm the view that mechanization cannot properly be regarded over a series of years as a cause of unemployment. At no period in history has mechanization proceeded at a greater rate than between 1881-1931. Yet in this period the proportion of men and women gainfully occupied rose from 41 per cent to 47 per cent : that is to say the amount of employment available increased faster than the population, and though in 1931—2,000,000 persons returned themselves as unemployed (all classes) less than a million had been out of work for over three months.

We may conclude therefore that mechanization, though it has a disturbing, has not had a catastrophic effect upon the structure of society. It has tended to increase output in terms of value of the work of almost all those employed in industry. This trend is accurately shown in the published

volumes of the *Census of Production*. Owing to the depressed state of the Cotton Trade, the net output per employee decreased between 1924 and 1930 by 21 per cent : but there were increases in the Hosiery and minor textile trade. In the Clothing Trades (including hat and shoe) the net output in England and Wales was slightly higher. Iron and Steel net output decreased slightly. In the Engineering, Shipbuilding and Vehicle Trades the output per head increased very substantially. Yet between these dates the sterling value of the commodities treated had slumped by at least 30 per cent. Progressive mechanization alone made it possible to maintain output, and therefore wages, at a higher level than in previous decades, based on the usual methods of computation from money, wages and the cost of living index. This index, moreover, takes no account of the multitude of cheapened miscellaneous items (cinema performances, bicycles, gramophone, etc.) which now form an integral part of the working-class family's real income (to say nothing of expensive medical services connected with the Health Insurance Acts). More is spent publicly on the children's welfare (better schooling, medical inspection, meals and milk for school children, etc.). while the social insurance schemes help to prevent the worst effects of bad times. If the well-being of the wage-earning families could be satisfactorily measured by the real income received, no account being taken of disappointed expectations and frustrated energies, this section of the population as a whole would appear to be

better off than in pre-war days. Elderly folk in all walks of life gain by the establishment in many forms of old age pensions consequent, in part, on the growth of industrial assurance. With the falling size of the family (which accounts for the great reduction in the total "dependants" in the population) it becomes possible, however much we may on other grounds regret it, for continually higher unemployment figures to emerge without the necessity of any reduction in average working-class incomes per head.

This result seems to be a direct and beneficent consequence of mechanization, for it is incontestable that in unmechanized countries the reduction of the standard of living has been far greater in proportion.

Fewer old people live with their grown-up children: they prefer in practice to live alone; the fact that economic conditions, in every walk of life, make it increasingly possible to do so in one of the most prized forms of freedom. A direct consequence of mechanization is the growth of institutional treatment—the sick and the dying, the mentally deficient, and those suffering from disabilities or ailments which prevent them from sharing social life are no longer a charge upon the household of their relations, but are maintained in special institutions where they can live a happier and, paradoxically, a freer life than as dependants in another's home.

Orphanages and training schools, whether under the control of the State or voluntary bodies, are in a different category, but they too make their

contribution to freedom : they too are a direct consequence of mechanization, which has increased the national wealth.

To mechanization we owe the fact that the sick in hospital can listen to radio concerts which were formerly the monopoly of the healthy few : to mechanization we owe a vast reduction in the amount of physical pain that men (and animals) must suffer in the course of their short lives. The invention of the wire rope, which made possible the electric lift, has effected a revolution in building forms, and in comfort, comparable to the invention of the wheel in the dim prehistoric past.

To mechanization we owe the development of printing, and its latest phase, the popular Press with its unrivalled power for good or ill. The fierce light of publicity may cleanse but, like other powerful rays, it may create an incurable sore. The publicity given in certain organs of the Press to the miseries of the private lives of helpless men and women, often defeats the ends of justice and spreads the very evil which the processes of law are designed to check. We must control the Press, like other developments of the machine, or it will control us.

It remains for us to consider the influence of the machine on the individual worker during his working hours. It is common ground that the average healthy man and woman prefers an active to an inactive life. It has long been recognized that intellectual power is a development of muscular sense and that the connection between hand and brain in man may be regarded as the source

of many of our higher mental faculties. The mentality of children who have been maimed in infancy tends to abnormality. Much has been written on the degrading effects on the mind of men and women engaged in machine-minding : for over a century it has been suggested that modern industry demands less intelligence from those whom it employs, and that in comparison with those of a century ago, modern industrial processes are demoralizing and brutalizing.

I believe this to be a one-sided and misleading view : it is based not upon an extensive survey of industry, but upon a few isolated processes—considered apart from the whole of which they are a part.

No woman who remembers the making and filling of match-boxes by hand would willingly abandon the machines of modern match factories, which employ more persons than were ever engaged in the business before it was mechanized. The peasant who has been wont to dig his land resorts, when he can, gladly to the plough, and the plough-boy to the tractor. Men who remember the filth and dust of the sawpit welcome the sawmill.

The proportion of so-called “ unskilled labour ” employed in industrial and agricultural processes is shrinking rapidly. The skill of the man behind the machine is different from that of his predecessor, but it is not less real : it involves quick and responsive eyes, and ears, and delicate touch, and an alert mind. Let those who doubt this visit the great technical schools of England, attendances at

which have doubled and, in places, trebled in thirty years in response to a steady commercial demand.

Mechanization may be, and is, a cause of unemployment when it is catastrophically sudden, affecting great numbers of men and women in a single industry. It is never so dangerous as when it affects a localized industry, on which the majority of the inhabitants of a whole town or region depend. The introduction of machinery in the coal-mines of England has been gradual: the worst effect has been avoided. The introduction of petroleum as a substitute for coal and as a motive power was equally gradual. Had coal-mining been an industry spread widely over the face of England, miners and their children would of their own volition have found other employment near their homes. But coal-mining is in fact highly localized and the miners, especially in South Wales and Durham, living in isolated communities, far from areas in which alternative employment might be obtained, have suffered greatly in consequence. Cab-drivers and draymen, on the other hand, suffered little from the oncoming of mechanical transport: they acquired a new skill. The same considerations apply to many other occupations.

But there is another side to the question. We have witnessed of recent years the creation of large industrial units—involving the closing of small factories which were often the only source of livelihood of the population of a whole village or town. The tendency has invariably been to con-

centrate industry in large centres involving fresh heavy expenditure on housing and municipal services, which often already existed in the smaller towns, or could be provided at a much lower cost. The ruling consideration in each case has been the financial advantage of the particular firm or group of firms. The indirect cost to the State of the transfer of an industry from North to South has had no bearing on such decisions, which do not require official approval, and to exact such a requirement would perhaps do more harm than good. The derating of productive industry was intended, but has failed, to exert a moderating influence.

This is not the place for a discussion of the claims of recreation and the use of leisure. But it is very necessary to protest against the assumption that the proper antidote to the monotony of specialized toil is shorter hours followed by more or less aimless "recreation". Few men and women who have left school at 14, and not many who have left school at 18, can be trusted to make the most of their leisure in a large city—inferior books, heavily thumbed and dingy from much use, cheap films, second-rate indoor sports are not recreation, and leisure thus spent soon palls.

Very many men and women wish to have a hobby which involves handicraft, whether it be a musical instrument, or the home-made wireless, fine knitting or the breeding of animals, gardening or carpentry. This form of recreation is not sterile, and those who have found therein what they need are the happier and stronger for it.

Their innermost feelings are expressed by Laurence Binyon :¹

' I am weary of doing and dating
The day with the things to be done,
This painful self translating, To
a language not mine own.

Give me to fashion a thing, -
Give me to shape and to mould,
I have found out the song I can sing,
I am happy, delivered, and bold.

Others require no more, after their work is done, than company, food and rest. The agricultural labourer with his knowledge of, and often tender sympathy with animal life, his watchings of the seasons, his weather lore, and his varied skill in many crafts, does not feel the same urge after-hours for the open air, or for handicraft, but I have met many who had a skill with their hands in strange crafts that a city man would envy greatly, and seldom attain.

In 1935, as always, man, not the machine which he has created, will make his own life worth living if he will aim at the highest standards he knows, those proclaimed by Christ two thousand years ago, which have done more to moralize and humanize mankind than all the disquisitions of the philosophers. The Spirit of God is within us, not in the machine.

¹ *The Secret* : Sixty Poems.

THE TRADE UNION VIEW

By WILL SHERWOOD, National Industrial Officer,
National Union of General and Municipal Workers,
and Member of the General Council of British Trade
Union Congress

At present there are approximately thirty million unemployed workers throughout the world. In our own country we have about two and a half million unemployed.

In great numbers of industries, new mechanical and new scientific processes are continuously increasing the output per worker, and the fact that fewer workers can produce the same quantity of goods is one of the main causes of unemployment. It would be a tremendous help if improved methods of production, instead of being used to penalize one section of the community, could be translated into leisure. It is surely foolish for two men to be working long hours, and one man idle, when three men working shorter hours, and enjoying more leisure, might accomplish the same task. And, thanks to technical improvements, the better distribution of work and leisure could be secured without any reduction in our standard of life.

One of the outstanding features of post-War economy is the enormous improvement in the technique of production, and the consequent

enormous increase in productive power. It is estimated that in the first half-dozen years after the War, the world production of wealth had increased to some 20 per cent above pre-War level. The productive possibilities have now risen even further. That has been very largely the result of new mechanical and new scientific processes, which have greatly increased the output per worker in innumerable industries. Examples of such increased productivity in British staple industries will be shown at a later stage.

In the Report on Hours of Work and Unemployment, issued by the International Labour Office, the following instances are given of increased production.

In the German iron and steel industry, output per man has risen between 1926 and 1929 by 51 per cent for cast iron, and 50 per cent for steel.

Output for all industrial workers in Sweden rose 26 per cent between 1923 and 1929.

Average output per person in United States manufacturing industries rose by 43 per cent between 1919 and 1927—rising in the American iron and steel industry by 55 per cent and in the automobile industry by 97 per cent.

In Canada, output per man in the chief groups of industries increased by 17 per cent between 1923 and 1929.

In Australia there was an increase of 19 per cent between 1922-3 and 1929-30.

In New Zealand, output increased by 15 per cent between 1925-6 and 1929-30.

In the last three countries (Canada, New Zea-

land, Australia) the increase was calculated according to the value produced, differences in price being ignored.

In Great Britain the increase in productivity has been not less marked. According to the MacMillan Report, the output per person employed in the manufacturing industries between 1924 and 1929 rose by 8 per cent ; in mines by 24 per cent ; and in industrial production in general by 11 per cent.

Power possibilities have grown incredibly within two centuries. In 1712 a steam engine was invented which developed 56 man-power. In 1772 a single engine produced 765 man-power. By 1871 it had grown to 20,000 man-power. By the 1880's a single reciprocating engine produced 234,000 times the work of man. This century, however, has something greater still to show. A single turbine unit, working on a 24-hour basis, produces 9,000,000 man-power.

Professor Soddy estimates that England's productive capacity has increased 4,000 per cent since the advent of power and the machine.

In a great manufacturing country like Great Britain the growth of mechanization is progressively increasing. Let us look at some examples drawn from the " key " industries of the nation.

COAL INDUSTRY

In 1913 there were employed below ground	.	891,000
" " " " " above "	.	214,000
Total		<u>1,105,000</u>

In 1931 there were employed below ground	.	686,000
" " " " above "	.	182,000
		<hr/>
Total	.	868,000
		<hr/>
In 1932 there were employed below ground	.	645,000
" " " " above "	.	174,000
		<hr/>
Total	.	819,000
		<hr/>
In 1933 there were employed below ground	.	619,000
" " " " above "	.	170,000
		<hr/>
Total	.	789,000
		<hr/>

Between 1913 and 1933 there has been a reduction of 316,000 work-people in the coal-mining industry of this country.

While between 1931 and 1933 there has been a reduction of 79,000 work-people in this industry.

In 1913 the total annual output was	.	287 million tons.
" " per person below ground	.	322 tons.
" " per person employed	.	260 tons.
In 1930 the total annual output was	.	244 million tons.
" " per person below ground	.	330 tons.
" " per person employed	.	262 tons.

The increased productivity per unit is shown by comparing 1920 with 1932, the figures being as follows :—

In 1920 an average daily output of 14·54 cwts., for which miners were paid £4 5s. 9d. per week.

In 1932 an average daily output of 21·97 cwts., for which miners were paid £2 1s. 11d. per week.

Therefore, while the miners' output has in-

creased by over 50 per cent since 1920, his wages have been reduced by over 50 per cent.

Machinery in the coal-mining industry:—

	Number of Coal- cutting Machines.	Number of Conveyors in use at Coal-face.	Total out- put of Coal obtained by Machines.	Percentage of total output cut by Machines.
1913	2,895	359	24.4	8.5
1931	7,371	3,137	76.9	35.0
1933	7,149	3,717	87.8	42.4

The preceding figures show an increase of 33.9 per cent in machine productivity, as compared with 1913, and mechanization goes on apace.

During 1932, out of a total of 4,646 conveyors and loaders, 2,482 were electrically driven. Electricity was in use at more than 60 per cent of the mines at work during that year.

The miner working at the coal-face is being rapidly replaced by coal-cutting machines, and he is gradually becoming merely a labourer filling coal on to a conveyor.

STEEL INDUSTRY

Take the Steel Industry for an example. Between 1924 and 1930 the total output of pig-iron declined by 15 per cent, but the total number of workers employed fell by 30 per cent—by twice as much; in the pure steel industry, output dropped by 12 per cent, but the labour force by 14 per cent; in the steel tube industry, output

actually rose by 9 per cent, while the number of workers fell slightly.

In 1924 each worker in the pig-iron trade was responsible for the production of 243 tons ; in 1930 his output had risen to 340 tons. The steel worker's output rose from 55 to 57 tons ; the tinsplate worker's from 29 to 30, and the steel tube worker's from 19 to 21 tons.

Recent figures yield even more remarkable results. In January, 1924, the 25,540 workers in employment in the pig-iron industry produced at the blast furnace 636,000 tons, or an average of 25 tons a month. Ten years later the number in employment had dropped by no less than 57 per cent, or down to 11,000, but the output of pig-iron from the furnaces had fallen by only 31 per cent, or down to 441,300 tons, and the worker's output was not 25 tons a month, but had jumped to 41 tons a month.

Is it surprising that the drift out of this highly rationalized industry has forced down the number of insured workers in it—working or not working—by nearly one-half, from 29,550 to 16,200, in ten short years ?

Take a modern blast furnace. The guaranteed capacity of the blast furnace before reconstruction was 1,500 tons per furnace, and each furnace was producing anything from 2,500 to 3,500 tons per week, thereby creating the world's record for that particular type of furnace. The furnace at present in operation is averaging 4,000 tons per week.

These furnaces have had installed a charger car which automatically unloads the bunker, ore,

coke or limestone, as the case may be, into a large container. This contrivance is also a weighing machine, so that the one man operator knows exactly the amount of material going into the box. This car deposits its load into an elevator which ascends and automatically charges the furnace.

The number of men required for that process is one, also one charger-driver, and one landing-man, thus making a total of three workmen. The number of men displaced from the back and front of the furnace is approximately 89.

During the process of pig-iron moulding, the moulds slowly revolve and the metal is tapped straight from the furnace into the mould. As it passes upwards, water is sprayed, and when the "pigs" reach the top they are automatically discharged straight into trucks which are weighed as they stand under the machinery.

The number of men displaced through the pig-casting plant is approximately 50.

ENGINEERING INDUSTRY

Employment was practically the same in 1930 as in 1924, but the MacMillan Report has shown that the index of production rose from 100 to 125·7. During these five years, production per head in engineering and shipbuilding rose by 23·7 per cent—almost one-quarter. This figure is greater than the average increase for all industries, which was 21 per cent.

In marine engineering the number of workers decreased by 3·6 per cent, but the total output (measured in horse-power) rose by 86 per cent,

whilst the output per man employed rose by 93 per cent in seven years.

Production of motor-cars in 1930 was practically the same as in 1929, 237,000 as against 239,000 ; but the percentage of unemployment practically doubled in the year, rising from 8·9 per cent to 16·2 per cent.

Briefly, with modern machinery, larger quantities of wealth are being produced per unit of labour ; and, therefore, the displacement of labour does not mean that less is produced. In every case (with the exception of the motor and cycle trades, in which there was a decrease of 1·0 per cent per person employed and 3·2 per cent per operative employed) the value of production per person has increased.

Physical production per person is now shown in the returns of the *Census of Production*. Examples of the amazing displacement of man-labour by machinery can be cited from many sources.

The number of employees per car per week at the Austin Motor Company's factory has fallen, as follows :—

55	men	per	car	per	week	in	1922
24	„		„		„		1923
20	„		„		„		1924
17	„		„		„		1925
12	„		„		„		1926
10	„		„		„		1927
7	„		„		„		1933

The boring of a lubricating hole in six connecting rods would take 20 hours to do by hand, but

a machine can do the same work instantaneously at a cost of 5*d*.

In 1918, at a tool-making plant, 480 men were employed with 16 drop-hammers; in 1927 the hammers had increased to 22, the number of workmen was reduced to 280; and the output was increased by 30 per cent—six extra hammers more than replacing 200 men.

Four men can do with an oxy-acetylene torch repairing work to locomotives which formerly took eight men to do. The length of time taken to turn a pair of locomotive tyres was formerly 15 to 30 hours—it can now be done in 1 hour 20 minutes.

A man with a power chisel can do the work of ten men.

An electrically driven saw, worked by one man, replaces four men.

No longer is the engineer expected to work one lathe. His work is now attending a battery of lathes—four to seven lathes per man.

Simplified forms of machine production has enabled a great increase in the number of women and girls employed in this industry. There is no record showing the number of girls, between the ages of 14 and 16, employed in the engineering industry, but the Ministry of Labour statistics show a progressive increase in the numbers of women employed, that is, from 1911 to 1933, as follows :—

1911-14	from	128,000	to	170,000
1914-24	„	170,000	„	202,000
1924-33	„	202,000	„	251,000

Women are now being employed on all forms of automatic machinery.

These and other factors have tended towards the dislocation of the system of apprenticeship, whereby a youth was trained for a period of five to seven years in his craft.

Specialization in sections of engineering is the method now commonly followed, and those entering the workshop are no longer given the opportunity to learn even a large part of engineering practice, but are confined to one section of specialized work, which, by simplification of the various engineering processes, induces greater productivity per unit, to the ultimate advantage of the employer. Craftsmanship deteriorates, whilst the machine-made article increases. Outside of model, tool and instrument making, there is little scope left for the initiative and ingenuity of an engineer, who is becoming more and more a slave to the belt or conveyor; a robot—machine minding, instead of machine controlling.

SHIPBUILDING INDUSTRY

The number of workers employed in shipbuilding and ship-repairing fell from 312,160 in 1920 to 141,418 in 1930, whereas the tonnage launched per man employed rose from 6.6 in 1920 to 10.4 in 1930. Figures relating to British shipbuilding show (taking the average of two five-year periods) that the number of workers employed fell from 237,000 in 1920-4 to 151,000 in 1926-30, or, by no less than 36 per cent, whilst, on the other hand, the tonnage launched fell by only 6 per cent.

In 1930 the total tonnage launched on the Clyde was 529,800 tons, as against 565,800 tons in 1929—only one-sixteenth less ; but during the year unemployment among shipyard workers almost doubled ; rising from 23 to 40 per cent.

Let us look at the evolution of the machine in the shipbuilding industry, which has had its effect upon large numbers of workmen employed.

In most yards there has been introduced, for a number of years past, a caulking machine for caulking wood decks, whereby one man can do as much work as twelve shipwrights can do with hand tools. The only parts now left for shipwrights to do are the awkward places, such as iron seams and butts.

There has also been introduced a hatch-making machine. Some years ago all wood hatches for main cargo hatches were made by hand. Two men would make six to eight hatches per day. By this machine the work is now done by a man and a boy, who put the planks together, after they have been cut to the correct length, when the connecting bolt holes are bored by the machine. The bolt is driven by the machine, and the handle hole is also bored by machinery. The operation of this machine means that one man and an apprentice now do the work of fourteen men.

On the laying of wood decks, pneumatic boring machines are in operation for the boring of holes for the deck bolts, as well as for the dowels on the top of the deck, and this means the work is being done in at least one-quarter of the time than when it was done by hand.

In the lay-out of a modern shipyard enormous changes have taken place during the past few years. 'Overhead equipment is such that entirely new methods have been adopted. There are whole forests of electric cranes, and with the introduction of gantry cranes, large numbers of workmen have been displaced.

In the iron-stowing department, where eight men were fully employed, three men now do the work.

Owing to the new method in the furnacing of plates, helpers' squads have been reduced by one-half. Platers' helpers' squads, with six to eight helpers, have been reduced to three helpers. In fact, they only start men working on jobs, such as furnace work of the frames and boat squads.

Instead of six to eight men, two men are employed to act as shoulderers opposite the plater, and tackle-man to hang and prepare the job for punching.

With the introduction of the multiple, or one-man punch, one squad varying from five to six helpers, together with a number of helpers on different operations, have been displaced.

In the same yard at Govan, " piano " punching machines are worked by boys. Platers mark the plates ; the machine then does the punching. Each of these machines have displaced twelve helpers.

Take the hydraulic machines for bending ships' frames, when cold. This machine is worked by one man and a boy ; displacing at least twelve helpers. While the new method of manipulating

the furnaces has reduced the number of men by 50 per cent.✓

Again, the new single drill punching machines with gear-belt drive table, operated by one man. Each of these machines have displaced six men. Certain strakes are punched from the moulds, and they are then ready for shipping into their place as soon as the frames are connected to the tank top. This cuts out the necessity of wooden ribbon supports.

The method of plating ships is being entirely revolutionized. So far as possible riveting and caulking will be abolished by the introduction of electric-welding. This means that a new class of craftsmen, called ship-welders, are to be created. There will be a direct displacement of machinists, riveters, blacksmiths, caulkers, holders-up, heaters and catcher-men, together with a partial displacement of engineers, sheet metal workers, plumbers and shipwrights.

Take the case of angle-iron smiths. Three welders can now do the work formerly done by thirty or forty men. Ten men used to cut out old rivets when repairing the bottom of a ship. Now, one man, with a blowlamp, has replaced them.

The effect of the use of electric and pneumatic drilling machines in the reduction of the number of men engaged as drillers, is well known. The introduction of oxy-acetylene burning machines has reduced the number of drillers by more than 50 per cent.

The use of mechanical appliances is lessening

the number of dockers required in loading and unloading, by more than one-third.

These are but examples of the effect of increased mechanization in the method of production in the shipbuilding industry ; could be multiplied, and if necessary, taken from every industry producing the material from the assembling of which ships are built.

The figures of the *Census of Production* prove conclusively the remarkable speeding-up of the shipbuilding and ship-repairing industry between 1924 and 1930. Further evidence accumulates elsewhere.

This speeding-up of the worker has been accompanied by remarkable technical progress. The use of mechanical stokers to feed water-tube boilers ; the advance on a new operation in the use of super-heaters ; the modification of hulls in shipbuilding by the Isherwood arcform vessels ; the expansion of the use of exhaust steam turbines ; the use of the exhaust gas boiler on a larger scale ; the streamlining of rudders and steam frames, etc., are all instances of this progress.

There have been changes in the organization of industry ; vast improvements in technical methods, and machinery, all made with the avowed object of producing economy, together with the increased productivity of men engaged in this industry, measured in tons or in horsepower.

Turn to examine, first, the figures of tonnage launched, and, secondly, the number of workers employed in the industry. Take two compara-

tive years when the shipbuilding industry has been most prosperous since the end of the War, and when the total tonnage launched was very much the same.

In 1924, 1,440,000 tons of merchant shipping were launched, and (on the basis of the figures in the middle of the year) the shipbuilding and ship-repairing industry employed, as wage-earners, 182,000 men. Each man produced 8·0 tons.

In 1928 the tonnage launched was slightly higher at 1,446,000 tons ; but there were working no less than 37,000 fewer. In that year each man at work produced 10·0 tons.

Between 1927 and 1930, the tonnage launched rose by 253,000 tons, but the number of men at work dropped by 28,070, while the tonnage output per man employed rose from 7·3 tons to 10·6 tons.

In other words, a rise of 20·7 per cent in output went hand in hand with a fall of 17·3 per cent in the number of wage-earners.

In the three-year period 1926-7-8, it reached 7·4 tons ; in the three years 1927-8-9, it was 9·0 tons ; in the three years 1928-9-30—the three busiest years since the War—it was no less than 10·2 tons.

On this basis, average output per worker rose from 6·5 tons in 1923-5 to 10·2 tons in 1928-30—or, by 57 per cent.

In 1924, on the Clyde, 37,800 workers launched 538,000 tons, or, 14·2 tons per man.

In 1929, 27,800 tons more were launched, but 500 fewer men were at work.

In 1930 the launches were slightly below the 1924 level by 8,000 tons (or about $1\frac{1}{2}$ per cent), but the workers employed had fallen by 5,800, or, by 15.3 per cent.

In 1924 each worker was responsible for 14.2 tons; in 1929 for 15.2 tons, and in 1930 for 16.6 tons.

On the Tyne and Tees, in 1929, tonnage under construction was slightly lower by 63,000 tons, or, by 4 per cent (as compared with the position at 1924), but the number of workers required had dropped by 19,000, or, by 12 per cent, while the output per worker had risen by over 8 per cent, reaching 9.2 tons per man.

In 1930 the position was even more remarkable. As compared with six years previously, the total tonnage under construction was down by about 8 per cent, but the number of workers necessary had slumped by over 20 per cent and each worker, in producing 9.8 tons, was producing at a rate of over 15 per cent above the 1924 level of individual output.

If we look at the position in another aspect, we can say that had the shipbuilding workers in Britain been producing at the same rate per man in 1930, as they had produced in 1924, the British yards would have employed in 1930 about 163,800 workers. In fact, they were employing in 1930 only 141,900 workers.

This speeding-up process, therefore (and not the economic state of the industry), had in six short years displaced from employment 21,900 workers.

In 1924 the net output of the shipbuilding industry was returned at £22,750,000. This was produced by 124,500 wage-earners.

In 1930 the net output had risen by over £3,000,000 and stood at £25,800,000; the number of wage-earners had fallen by nearly 10,000 and stood at 114,800. Where each worker produced 2·4 tons in 1924, he was producing nearly twice as much—4·2 tons—in 1930.

Where each worker had a net output of £169 in 1924 (or £3 3s. a week), he had a net output of £210 in 1930 (or £4 1s. per week).

As the average wage per worker in 1930—skilled, semi-skilled, and unskilled, man and boy—could not have exceeded 50s. a week, this meant that he was producing in net output 31s. per week over and above his own earnings.

The official figures of the Board of Trade show that, in money value alone, the produce of his labour in shipbuilding increased from 1924 to 1930 by 24 per cent, while his output in volume rose by no less than 75 per cent.

It is not only in the mechanical field that improvements have been made. Reorganization of the shipbuilding industry has proceeded fairly rapidly during recent years, and the result has been to produce economies in labour, and to increase productivity in general.

The formation of National Shipbuilders' Security, Limited, gave a powerful stimulus to this movement. Shipbuilders representing practically all the shipbuilding industry of Great Britain, Northern Ireland and the Irish Free State, who

build vessels of 300 feet or more in length, have become members of the Company.

So far, the Company has closed twenty-seven shipbuilding yards, mainly on the Clyde and North-East Coast, involving 137 berths, and an annual capacity of nearly 1,000,000 tons.

Along with rationalization and mechanization an impetus has been given to amalgamation. In general, amalgamation took one or both of two forms—the amalgamation horizontally of a number of shipyards and marine engineering establishments under one control, or, the amalgamation vertically of the suppliers of coal and steel, or, the shipowners with the shipbuilders.

An outstanding instance of this second type of huge amalgamation, reaching backwards to grasp its own coalpits and steelworks, and reaching forward to own its own vessels, or, to invest some of its shipbuilding profits in shipowning companies, is the great Belfast firm of Harland & Wolff, Ltd.

Amongst the subsidiaries of this combine are : Caird & Co., Ltd., of Greenock. Burmeister & Wain (Diesel System) Oil Engine Co., Ltd. A. J. Inglis, Ltd., of Glasgow. David and William Henderson & Co., Ltd. British Motor Ship Co., Ltd. Ocean Transport Co., Ltd., and even a furniture-making firm in Heaton, Tubb & Co., Ltd.

In the Clyde Valley, with its shipyards, it has become the owner of one of the greatest steel makers in Britain in the £3,750,000 David Colville, Ltd. It has its own coalpits, run by the

firm of Archibald Russell, Ltd. ; its own lime-works ; its own engineering concern in Smith & McLean, Ltd. ; its own alloy steel works in the Clyde Alloy Steel Company ; its own foundry in the Fullwood Foundry Company ; and even its own patent fuel company to absorb the slack from its pits. All these are subsidiaries of David Colville as Colville's is a subsidiary of Harland & Wolff, Ltd.

BUILDING INDUSTRY

During the winter of 1932, 350,000 work-people were unemployed in the building industry, and in the middle of summer, 1934, there were 151,660 unemployed, with little hope of employment.

Modern architecture has undergone revolutionary changes during the last fifteen to twenty years, and statistics show that it is devised to get the utmost out of the machine. The buildings are actually designed with plain straight lines, with no breaks or reveals in the fabric which would interfere with the continual use of machinery.

Joinery work is being produced in big factories at a high rate of production, and sent all over the country, and simplicity is adopted because it gives a bigger opportunity of standardization.

In plastering, new materials and substances are being used, and little decorative work is under taken.

Steel is being used more and more in modern buildings, and stone and brick are becoming little more than a veneer.

We can inspect the whole industry and see new mechanical processes obliterating skill. Cranes, petrol and electric appliances, concrete mixers, crushers, and power machines are now commonplace.

TEXTILE INDUSTRY.

Application of the six looms per weaver system, and the increased simplification of the processes, has meant a reduction of almost 33 per cent in the number of work-people engaged.

On the productive side a conveyor system has been introduced whereby twenty girls work to produce but a section each of a shirt, while the conveyor carries the material to the girl working at her machine.

This speeding-up process is general throughout the make-up industries. The work is performed by a slight operation to the material, and then the work is passed on to a running belt, or platform, to the next person, until it is completed.

RAILWAY INDUSTRY

Mechanization on the railways shows that while the train miles, in coaching, per train hour has advanced from 12.99 in 1920 to 14.85 in 1933, and the train miles per engine hour from 10.10 to 11.58, and the increase in freight per train hour shows an advance from 7.74 in 1920 to 9.49 in 1933, and the freight traffic of 1921 set forth in average train loads in tons of 121.17, as against 122.21 in 1933, with an increase of the average net ton miles per engine hour from 412.93 to 451.37—an

increase of 10 and 15 per cent, the total number of employees have been reduced from 735,870 in 1921 to 566,300 in 1933, thus showing an increase in both mileage and train loads, with a reduction of 69,570 work-people.

Coal trains have been enlarged from 35 to, say, 75 wagons, and the time allowed for the journey has been reduced by 75 per cent.

In 1928 twelve days was the record time for a locomotive out of traffic for heavy repairs. This time has now been halved. At Crewe, men spoke of months where now they break records in hours. Thus a particular type of engine in 1920 for reconditioning took $2\frac{1}{2}$ months ; in 1925 $5\frac{1}{2}$ weeks ; in 1927 12 days, and in 1930 47 working hours.

Running expenses, maintenance and capital charges have been reduced by a more intensive use of engines, and by a reduction in the time occupied in shop overhauls. Numerous experiments are in progress with lighter units, and with Diesel and Diesel-electric vehicles.

Many schemes of signalling reorganization have been carried out. For example, on the Southern Railway, the signalling arrangements have been so remodelled that the Company has been able to close down 200 signal boxes.

So far as maintenance is concerned there has been a considerable extension of the motor-trolley system. Under this system the staff are moved along the track by petrol motors, which enables small gangs maintaining three-quarters of a mile of track to be replaced by large gangs covering up to fifteen miles, with appreciable staff savings.

The L.N.E.R. now carries out 31 per cent of its permanent-way work by this system.

AGRICULTURAL INDUSTRY

In the oldest industry in the world mechanization begins to rapidly displace manual labour. The machine takes the place of the horse in ploughing and other field operations. A mechanical marvel is the harvester-combine, which reaps and threshes in one operation. Then there are improved methods of transporting and milling, for all of which less labour is needed. The harvest is over three weeks earlier than usual, and thousands of farm workers are thrown out of work until the spring sowings are commenced.

Preliminary returns of this year's (1934) census of agricultural labour reveal that though the output of farm produce is up, the number of farm workers employed is 21,000 down. In ten years there has been a drop of nearly 90,000 workers.

GENERAL

It cannot now be disputed that a very large proportion of the existing unemployment is the outcome of changing conditions in industry. In one industry after another, unemployment is increasing as a result of new methods of production, rationalization and mechanization. Science and invention are making human labour less necessary, whilst new opportunities of employment for the workers displaced by machinery do not present themselves. The increased productivity is largely due to the fact that the use of power has

brought in its train the introduction of new or improved machinery, and the mechanization of labour resulting from the systematic use of power-driven machinery has been carried a stage further by the development of mechanical systems of internal transport, together with the processes of automatic feeding of machine tools and automatic clearing of products. By the combined action of the various mechanisms of production and circulation, the factory comes to function as one huge machine. That machine ought to produce leisure, but the only leisure it produces is that of unemployment.

Under these conditions, it is plain common sense to distribute work and leisure more equitably. Economists, engineers and industrialists seem agreed that the productivity of industry is fast increasing and is likely to continue its rapid evolution. If this be so, there is growing force in the contention that what the world most needs, in preparation for higher levels of material wealth, is a wider distribution of leisure wherein to cultivate the art of consumption and the art of intelligent living. From this viewpoint, the shorter working week is not merely a measure made opportune by the present extremity, but an essential element in any long-range planning.

The growth of machine production means, not only unemployment, but lessened opportunities for work. On Clydeside there are 8,000 youngsters waiting for work. By 1937 their numbers will have swollen to 13,000. Hundreds of them have not yet done a day's work. They

are waiting their opportunity with the unquenchable optimism of youth. Unless there is some drastic change in the social system, some bold, far-sighted scheme evolved, new industries developed, that chance will never come, and what is now magnificent human material, will become a race of disillusioned, demoralized men and women.

The prospects of the situation righting itself automatically are remote. Apart from other considerations, the next few years will see a great increase in the numbers of young people pouring out of the schools into the labour market, the result of the increased birth-rate of early post-War years.

There were in 1933 160,000 young people unemployed. Yet 309,798 boys and 303,904 girls left during the school-year ending 1932-3. This is a total of 613,702.

During the next twelve months almost a quarter of a million more children will reach school-leaving age than in the year 1932-3—the figures as disclosed by the 1931 Census being—432,526 boys and 421,793 girls, a total of 854,319.

Are we going to doom these children to a life-long struggle with poverty because the rationalization—or derationalization—of industry precludes them from getting a job? Or, are we going to reduce the hours of work, and take a step towards making industry rational in the true sense, so that even boys and girls may play their parts for the common good?

CONCLUSION

Labour organizations have long contended that, in order to sustain a larger volume of production, and to extend the benefits of more efficient methods of production to the working-classes, there must be a comprehensive policy of shortening hours, and of diverting surplus income into higher wage rates.

Why should science enable us to produce with less labour if the result is not to give us more leisure? The whole object of scientific improvements is to free mankind from the burden of unnecessary toil. The greater leisure we claim by the adoption of the 40-hour week, without reduction in pay, is merely the logical corollary of advances in industrial productivity.

THE ECONOMIST'S VIEW

By E. F. M. DURBIN

I

MACHINES AND INDUSTRIAL OUTPUT

IT is remarkable that economists are not forbidden by law. They are certainly the most irritating people in the world and it is surprising that in these days of dying tolerance and growing oppression they have been allowed to continue in their exasperating ways so long. No one really loves an economist because in every age and in every place he makes himself the enemy of the most hopeful and inspiring social programmes. If an engineer or an atomic chemist comes forward with a proposal to make some simple alteration in the credit policy of the banks which—according to this engineer or chemist—will enormously increase the output of industry and enable us to live at ease for the rest of our lives there is sure to be some carping economist next door who throws doubt upon these golden hopes and criticizes these simple panaceas. In the same way when a Trade Union official or the more humanitarian social worker makes the hopeful suggestion that the unemployment problem could be cured by everyone working shorter hours and receiving

the same wage it is once more the wretched economist who doubts and boggles over the whole thing. As a Trade Union official said in America not long ago, "The only way to cure the depression is to put all the economists in the world into one concentration camp and feed them on bread and water without the bread." Most people must think there is a lot in that.

Economists, irritating as they always are, are not however always wrong. It was the economists who were right about why prices rose during the Great War, and it was economists who warned the country of the dangers of returning to the Gold Standard as and when we did in 1925. At least one group of economists prophesied the coming of the depression in 1929 and put their finger on the real cause of the trouble. And it was economists who even in the worst years of 1931 and 1932 knew that the recovery that is now taking place all over the world would certainly come. Even the most irritating men have their uses.

The thing which makes economists so irritating is in fact the nature of the work they do. This they cannot help. But it is also partly due to one particular habit they have adopted in recent years which is *wholly* their own fault. The thing they cannot help is that they must be critical and scientific about every proposal that is made. They must examine it in detail and work out its difficulties and discover what they think would really happen if such proposals were carried out. Such an activity *sounds* harmless enough and it

would be harmless enough but for the fact that ordinary people behave and think oddly about economic affairs—they think they understand all about them without studying them or knowing what other people have found out about them. The ordinary man doesn't expect to know everything about his car or his motor-bike without consulting an engineer or a textbook on automobile construction, or to know about his teeth without going to a dentist, or about stars without consulting an astronomer—but he does expect to know everything about free trade and tariffs, or prosperity, or what money wages ought to be without any aid from the economist who has studied these things. It is naturally irritating for the "practical business man" or the "practical Trade Union leader" or the "plain working man" to have his chosen schemes and ideas upset and criticized. But the economist can't help that. It is his business, the thing he is paid to do, to examine these schemes and to show what they really mean. It is his business, for example, to examine the potential capacity of the existing industrial machine and to tell us that it could be increased by about 10 per cent or 15 per cent above the level reached in 1929 or by 50 per cent to 70 per cent above what it is now in America, and to point out that it is nothing like the 1,500 per cent to 1,600 per cent which a Major Douglas or a "technocrat" will promise. And again if he (the economist) is told that unemployment can be cured by reducing hours without reducing wages he must ask how the competitive employer

is to carry on with his labour costs forced up in this way and if he cannot carry on how unemployment is to be cured. This is the economist's work and if it is unpopular he must stand the racket.

But there is another and a more justifiable source of the present dislike of economists—and that is that the economist too often stops short at this negative and destructive criticism. He is so impressed with the ignorance and prejudice upon which popular ideas are based and so appalled by the obstinacy and violence with which these views are held that he thinks he has done his work if he exposes the weakness of the logical foundations upon which they are built and boldly pronounces them wrong. But of course he has not finished his work. He has only half-finished it. People must know not only what is wrong but also what is right. They must not only be discouraged from hoping for the impossible, they must also be led to hope and desire the possible—even if it is very little better than the actual state of affairs. It is not enough for the economist to tell people that policies of “social credit” will not cure poverty or reducing hours will not cure unemployment. He must also explain how unemployment *can* be cured and the extent to which output *can in fact* be raised. Otherwise he leaves the average man without hope and the average man will be right to think that this is a ridiculous position, that it cannot be true that nothing can be done, that there is no way in which the victories of science can be turned to the use and

service of men. If the economist will throw no light upon the path forward the average man will turn, and rightly turn in my view, to someone who will. The economist must, in short, provide a policy as well as destroying other people's policies. He must be "constructive" in thought as much as, or more than, he is critical. Only so can he contribute to the solution of our social problems.

And that brings me to MACHINES. I am an economist and as an economist it is my business to examine and criticize the complaints which are made about the effects of introducing modern machinery into industry, and the proposals that other people put forward to deal with the problems machines create. But it is not my business to stop at that point. I must go on to say how I think these problems should be solved and this I shall do my best to do.

II

THE CASE AGAINST MACHINES

There are two general complaints against the introduction of machines and the contemporary growth of mechanical aids to labour which are commonly made by the present generation of workers and employers. Many examples of both these types of complaint are to be found in the preceding pages of this book.

In the *first* place it is contended that the introduction of new and more powerful machines *replaces labour, causes unemployment and reduces real*

wages. The people who hold this view will argue that if we examine any typical modern invention we shall find that its introduction leads to a sudden and large displacement of labour. The installation of a chain conveyor for goods will dispense with the services of a dozen or a hundred transport workers in a month. The use of an electric drill or of a blasting technique will enable one man to take over a coal fire which previously employed three to five men or more. The substitution of standardized parts and the conveyor system for individual model production will enable a thousand men in a car factory to increase output by three or four hundred per cent. The mechanization of railway signalling has cut down the number of men employed in the boxes to a quarter of what it was. Such examples could be continued *ad nauseam*.

In all these cases, continues the argument, the installation of machines has rendered the services of tens, or hundreds or even thousands of manual workers unnecessary and substituted for them a few scores of machine tenders and office workers to keep accounts. And so there is all over the system a superfluity of labour which has the immediate consequence of greatly increasing the volume of unemployment and the long run consequence of reducing wages because the displaced workers will compete with those who are fortunate enough to remain in employment and enable the employer to engage unemployed workers to reduce considerably the level of real wages. By this means the general purchasing

power of the community is reduced and the increasing flood of commodities is launched upon a diminishing market. Prices fall and confusion results. Thus, it is contended, the introduction of machinery is the root of our economic ills and inevitably produces the apparent condition of over-production.

Nor is this all, for it is argued in the *second* place that machines result in the degradation of the conditions of employment in that they make work *more mechanical, more wearing and more dangerous*. No one with humanitarian interests can help being impressed by the lament of the older workers that their skill, their security and their history is slowly but surely being filched away from them by the endless victory of the machine. Whether it is the coal-heaver, or power-loom worker, clerk or agricultural labourer, engine or bus-driver, there is everywhere the complaint that the slow accumulations of manual dexterity are rendered useless and out of date, and that an increased pace of production is wearing down the nerves and bodies of human beings. The growing strain of disciplined and rhythmic productive techniques, the encroachment of whirling and grinding bands and chains, the noise and danger of the modern mine or factory is, according to the older workers, imposing an intolerable strain upon hand, eye and nerve and is changing the tolerable routine of the older techniques of production into a nightmare of effort.

Such changes as these constitute a serious indictment against the present tendencies of the

industrial system and they cannot be lightly answered. Before I proceed to examine them in greater detail, however, I wish to see what the ordinary worker and Trade Union official proposes to do about it—about the cases which suggest themselves to the minds of those who are in direct and practical contact with the evils that are denounced. It is obvious after a glance at the papers preceding in this book that the remedies are explained with much less force and clarity than the evils are denounced. In some cases indeed no remedy is proposed or hoped for. The individuals seem overwhelmed with the magnitude of the problems and resign themselves with despair to the flood of change. This is not, however, always the case, and there emerge two general proposals of very different value in the course of discussion.

1. There is first the recrudescence in a modern and orderly form of the destructive hopelessness of the first machine breakers. Machines were regarded as the natural enemy of the worker and a complete cessation in their further elaboration and introduction is suggested. Existing techniques of production must be continued indefinitely and the pace of technical advance must be reduced to nothing. Let us stay where we are lest worse than we yet know befall us, argue the pessimists. Let us reject the fruit of scientific inquiry and establish our right to live as we have lived without hope but without fear. Science has released forces of change too powerful to control and has robbed mankind of that minimum of stability in the conditions of daily work without

which progress in happiness is impossible. Science must therefore be condemned in the technical sphere.

It is obvious that this is a counsel of despair and nothing more. To stop technical advance altogether would not only limit us for ever to the existing volume of production with all the poverty and insufficient consumption that we can see everywhere about us, but it is for our country a particularly hopeless and dangerous suggestion. For good or ill we have allowed our population to grow to a size greatly in excess of the largest that we could (from our own unaided resources) maintain at anything like the present standard of living. We import four-fifths of some of our essential foodstuffs and as much as nine-tenths of certain classes of raw material, and over the whole range of food and raw material supplies we import something like one-half of the present total. Without suggesting that if we really turned our mechanical skill and accumulated capital to the further development of our agriculture and home supplies of basic material we could not greatly increase the volume of our home production, it is nevertheless certain that we could not sever our economic relations with the rest of the world without great economic suffering. If we are even to retain our present standard of living, much more so if we are to increase it, we must continue and increase the volume of our foreign trade. In short, we must have imports.

Now a country can only command part of the

produce of other economic systems if it can succeed in selling commodities to them. We can only keep up our imports by maintaining the volume of our exports, and it is this fact which constitutes one of the most serious arguments against impeding the rate of technical advance. If we reduce the rate at which technical improvements can be made by our producers and hold back the installation of machinery by them at a time when no similar restriction is placed upon their competitors abroad, the trading position of this country would rapidly deteriorate and the value of our imports would fall. In foreign trade the race must go to the ruthless and the strong, and we at least are committed for our economic future to the fortunes of our foreign trade. There can therefore be no complete cessation of technical invention or of the increasing efficiency if we are to hold our own in the markets of the world.

2. There is, however, a second stream of thought which recognizes this fact and makes no suggestion that technical progress should be wholly stopped. Instead it proposes in a less precise way that new machines should be introduced but that their introduction should be "scientifically controlled" and adopted in some unspecified way to the "social need". In particular it is commonly, almost universally, proposed that the increased efficiency or productivity of the machines should be used to benefit the worker by *reducing hours and maintaining wages*. In this way it is supposed that while the strain

of greater mechanization will not be avoided during the actual hours of labour the individual worker, will have greater leisure in which to recuperate from them—while unemployment will be wholly avoided and purchasing power will be increased.

This is a much more important suggestion and the frequency with which it is made and the intensity of the faith the average worker feels for it makes it into the most serious question that we have to examine. It is true that such a policy would not render the conditions of labour less difficult or dangerous, but it yields an immediate and tangible benefit to the individual worker which makes some direct compensation to him for the greater strain and danger of his work and might be reasonably expected to reconcile him to the changes he is called upon to undergo. The policy seems at once the solution of the problem of the machine and to open up the possibility of rapid and considerable improvements in the condition of life. It is therefore no wonder that it has been so universally adopted by workers and is advanced everywhere by their representatives to-day.

It is to assess the validity of this view that we must now turn. But before we can possibly pass a final judgment on the matter it is vital to understand far more deeply the real economic significance of the machine and to analyse the way in which it is incorporated into the structure of economic life. It is the purpose of the next three sections to perform this task.

III

THE FUNDAMENTAL NATURE OF THE MACHINE

Let us begin our task of analysing the function of the machine by an extreme assumption—namely that all machines are suddenly destroyed. A comparison between a world full of machines and a world empty of machines should tell us something of what machines really do. Let us therefore imagine that in a single night the whole railway systems of the world, the mercantile marine upon the seas, the improvements to land and road communications, every factory and every mine, engines, motors, looms, ploughs, drills, cranes, cutting tools, building tools and even the improvements to the land and natural resources of the world, are all swept away. Everything that can be described as a machine, everything that in any period of the world's history has "replaced labour and created unemployment" is finally destroyed. In the morning which succeeds this holocaust of the Machine what differences would appear in the various areas of the earth?

It is obvious that in many areas of the earth and among many groups of men the world would not look greatly different nor would anyone experience any major change. In Patagonia, in the South Seas, among the tribes of the dense equatorial jungles of the upper Amazon, with the nomadic hordes of Arabia as in the huts of Iceland, no very great revolution in technique would occur. It is true that if their spears and arrows and skin canoes, their beasts of burden and their rude stone and

iron implements are regarded as "machines" and have therefore been destroyed their power to maintain themselves in a different environment will be correspondingly reduced. But since they have no great steel machines or complex means of communication their productive technique will not be profoundly disturbed and it will not be impossible for them to subsist—or for large numbers of them to subsist—during a period in which they can construct their rude implements again.

But what of the great industrial peoples of the world? One hundred and twenty millions of people would find themselves deprived of all the complex means of production by which they had lived in the wide areas of the United States of America. New York and its five million inhabitants, Chicago and its two million, Boston and Philadelphia with one million people would soon exhaust the small stores of food that were available within the limits of the city and would then face starvation since the means of communication by which labour had been replaced would no longer bring grain and meat from the countryside. All forms of manufacture would cease and industrial unemployment would rise from 15 per cent or 20 per cent to 100 per cent in a day. As soon as the stocks of food were near exhaustion the great exodus from the cities would begin and enormous hordes of starving people would stream forth into the open countryside to consume the stores that still remained in the Middle-West. These stores would in their turn be rapidly

exhausted and mechanized agriculture would be unable to replace them since it would have also been wiped out. The wandering hordes would soon resume the life of half-savage nomads in which condition three-quarters of the people would perish. The brief chapter of civilization, industry, and high productivity in America would come to an inglorious end. The Red Indian would resume his natural command of wood and prairie.

The fate of our own poor England would be so much the worse. The density of population in the United States is approximately 125 per square mile. In England it is nearly 500! As the starving millions fled out from London and Birmingham, from Bristol and Liverpool and Newcastle, they would find a smaller area and a less hopeful countryside for the commencement of nomadic savagery. Nine-tenths rather than three-quarters of the population would starve to death and in a few short years a miserable shivering remnant of our proud people would be creeping among the ruins of once prosperous cities in the tattered fragments of their machine-made clothing.

Nor is this picture in the least fanciful. It is the calm and sober account of what would happen in a world deprived of machines. Of course, I know that no one proposes such an extreme or destructive policy. No one proposes to *destroy* machines at all but only to reduce the rapidity with which new machines are installed. Yet it is of the greatest consequence to understand just how important machines are and the full extent

of the difference they make to the form of life we are free to live. And it is no exaggeration to say that they are the universal and necessary basis of the whole of modern civilization. It is open to anyone to reject that civilization and prefer the conditions of primitive peoples, but it is not possible to repudiate machines and stop short of repudiating civilization.

This very brief inquiry into a world "freed from machines" demonstrates the validity of two propositions clearly albeit superficially :

1. It can be taken as axiomatic that the whole difference between primitive conditions and the industrial life we know lies in the possession of a stock of power machines and the knowledge and the skill with which to use them. The one type of thing is no use without the other. It would be just as foolish to let loose a horde of untrained savages in a modern textile factory or Mr. Ford's motor works at Detroit and expect a high output of cloth and cars as it would be to expect the same thing from a force of competent machine makers and tenders shipwrecked on a desert island. Skilled mechanics must have machines and machines must be served by men in whom generations of skill and "machine consciousness" is embodied. But the whole difference between huts and camp fires and primitiveness on the one hand and all that we mean by industrial life and a high standard of living on the other is to be found in the co-operation of man and the machine.

2. And an even more important conclusion for policy follows directly from this proposition and

that is that the only method of advance lies along the road that we have already come—the only hope of a higher standard of living and a greater productivity is a still greater development of machine production. It is only by more machines and better machines that we can possibly expect the productivity of society to be further developed. There are not many new areas of the world to open up. We can easily train human beings to any level of mechanical efficiency that we please. The only important source of great and undiscovered improvements lies in still further technical discovery and the embodiment of such discovery in ever more powerful machines. This essential point I shall hope to demonstrate more fully in a moment.

The truth is that the modern movement against the modern machine is not modern at all. Resistance to mechanical invention and innovation is as old as the Industrial Revolution. Each generation of workers and employers considers the machines with which they were brought up, to the production and use of which their industries have become set, as the right or normal level of mechanization. Each generation forgets that the instruments that they use were regarded as the dangerous enemies of labour by their forefathers. The steam engine was as revolutionary a source of power in its day as electricity in ours and was responsible for just such an apparent reduction in the need for labour. Yet it remains true that upon steam power, and upon steam power alone, the enormous development of productivity and

the great increase in the real demand for labour that occurred in the nineteenth century was founded.

Why is this so? What is the characteristic of the machine that makes it the basis of high production? Why are machines essential to a high standard of life and to a relatively large demand for labour? This is the more fundamental question that we must now answer.



IV

THE FUNCTION OF THE MACHINE

The standard of living of the whole community depends in the last resort upon its power to produce finished commodities. Our real standard of living consists in the food that we eat, the clothes that we wear, the houses that we live in, the holidays that we enjoy, the books that we read and the gramophones to which we listen. Our demand or need for these things as a whole is almost unlimited. We could all enjoy twice as large a real income as we actually possess and most of us a great deal more than that. But to enable the community to raise its standard of living there must be an increased physical production of food, clothes, houses, railway journeys, books and gramophones.

At a time like the present—in the middle of one of the periodical depressions from which the capitalist system suffers—it would appear at first sight as though almost any desirable increase in physical production could be secured. We know

that there is unemployment in almost every industry and that agriculture, mining, building, railway and consumption-goods industries are all working below capacity. And it is quite true that if we could cure unemployment and prevent these big oscillations of trade altogether we could and should greatly increase our physical production. We could increase it by at least 30 per cent in our own country. But that is the only change and the limit of the possible improvement we could secure as long as our technical equipment remains what it is.

It is easy to see, therefore, that a great deal of nonsense has been talked in recent times about "the problem of production having been solved". We have made continuous advances in the field of production for a century and a half now and we are still, fortunately for ourselves, making further progress. But we have a long way to go before our standard of living is doubled and before poverty as we know it is banished. It is calculated that in the second half of the nineteenth century (1850-1900) physical production in this country was increased by 400 per cent. Four tons of wheat and four yards of cloth were consumed for every single ton of wheat and yard of cloth that had previously been consumed. As the population doubled during the period this physical increase resulted in a doubling of the average standard of living. But to double that output again—which we must do if we are to double the present standard of living—will mean the same sort of prodigious industrial changes as we know

to have accompanied the developments of the nineteenth century.

How was this increase in output obtained in the past and how can it be obtained in the future? In the past it was undoubtedly obtained from the machine. In the future it will certainly be obtained from no other source: That is the essential and vital character of the machine—it *increases physical production and economizes human labour*. Whether we take a type of the most primitive machine or an example of the most modern machine, the power to increase physical output is the characteristic of them all. The introduction of the crudest knife or the most simple plough, for example, will double or treble the wood that a primitive savage can gather or double the area that the primitive husbandman can sow. When this desirable result is obtained, then the use of the machine opens up three possible courses to our primitive labourer:—

1. He can work as long at that employment and enjoy double the output of wood or wheat.

2. He can produce less than double the quantity of these commodities and use the time so gained *to obtain some other commodity* which he had not time to cultivate or hunt before.

3. He can use part or all of the time he gains to reduce his hours of labour and increase his enjoyment of leisure. But it must be remembered that if he uses the whole of the time that he gains for lying in the sun and enjoying the fruits of his labour he will produce *nothing more* than he produced before, and his standard of living will

remain exactly what it was except that he will have more time at his disposal to enjoy himself and less time for work.

Now the essential power of the machine to increase output and to open up those three possible courses to the individual and to society remains quite unchanged if we take a less primitive example. The only purpose for introducing a power loom into a modern textile factory or a mechanical conveyor into a mine or electrical signals on a railway is to "save money" and this it cannot do unless it "reduces labour costs" or "saves labour". Whatever we may think of this process in detail, and we will examine it in a moment, there can be no question that this actually represents the general beneficent power of machines to increase production. The installation of loom or conveyor or electric signal means that one man can produce twice as much cloth, or carry three times as much coal, or control four times as much of a railway line as he could do before, and that in respect of producing the things which the community really needs, the labour force is twice or three times as efficient. At once the same choice between three essentially different courses arises for society as in the more primitive case it arose for the individual.

1. Society can, if it wishes, retain the same labour force in the textile or coal industry and enjoy double or treble the output of cloth or coal. If society chooses to do this the economist would say that there was an "elastic demand" for the commodity in question.

2. On the other hand the community may not want as much as double the quantity of coal. It may desire a little more coal as its standard of living rises but not twice as much. Instead the general body of consumers may prefer to have a 50 per cent increase in the output of coal but for the rest it would prefer an increased consumption of wireless sets. This is the second fundamental alternative uses which part of the increased productive power brought into one industry by the machine to enjoy a greater consumption of the product of another. Such a choice, however, is not as simple as the first since it causes a second problem to appear. Labour must now be transferred out of the coal industry into the wireless industry if the output of wireless instruments is to be increased. That is a problem of real adjustment which is quite different and altogether more serious than any considered so far. To this point we shall return.

3. Finally, the body of consumers in society, who are also the producers, may choose the third course and decide to leave production everywhere as it is and to use the increased power of labour to reduce hours in the mining industry. This course reduces the burden of adjustment to a minimum and it yields a plain and direct increase of leisure to the workers employed in the industry, but it must be remembered that it prevents output from rising and holds down the standard of living to the existing level. It is impossible to use one increase in production both to increase leisure and to increase output to a maximum. That

would be to have one's cake and eat it too. It is, of course, possible to use the one invention both to increase output and to reduce hours in part, but the two ends are in general and in quantity quite antithetical to each other.

If this account of the real economic significance of the machine is really true a number of important conclusions follow directly from it.

First and foremost it cannot be true that the introduction of machines is really responsible for general unemployment. On the contrary, since the installation of machinery greatly increases the flow of finished goods out of which wages, in common with all other real incomes, must be paid it will in the long run greatly increase the real demand for labour. And yet it would be foolish to deny the experience of large numbers of workers and of large groups also that machinery has forced *them* into unemployment. How is it possible to reconcile this apparent contradiction?

The reconciliation is really not very difficult to discover. It can be found merely by distinguishing between the short period and the long and between one industry and the whole industrial system. It is certain that in many cases where a large installation of machinery is made in a single industry the demand for whose product does not increase proportionately (the second case examined above) that *a considerable volume of unemployment will be immediately created in that industry*. If, for example, electrical signalling is introduced into railways displacing three out of every four signalmen at a time when the railway

industry is scarcely expanding at all a large volume of unemployment among signalmen is bound to result. That is an indubitable fact and the existence of a considerable volume of technological unemployment during periods of *rapid* technical change must be expected.

But it is not a continuous and inevitable process, for these three reasons :—

1. There will in most industries be some increase in output after a time as a result of the fall in prices that reduced costs make possible. This will reabsorb into the same industry part of the labour that was originally displaced from it.

2. Just in so far as there is a reduced expenditure on this particular product there will, in the long run, be an exactly equal increase in the expenditure on some other product, since there is no reason to believe that the total money income of the community will decline. This does not, unfortunately, mean that the men actually thrown out of work in one industry will be reabsorbed into this new and expanding industry. On the contrary the new industry may be hundreds of miles away from the old, and the excluded workers may never know of the opportunities for employment in it or realize that the higher wages offered in distant districts indicate the possibility of obtaining work. What will happen, however, is that new labour—young men and women—will find openings in the expanding industries and that as the older unemployed workers pass beyond the normal employment age, unemployment will disappear in the older industries, and the labour

force as a whole will be redistributed between industries in the way that economic progress requires.

3. In the long period also there always has been some reduction in hours. Labour is thus absorbed everywhere in the industrial system and society makes a practical use of its third alternative—that of enjoying an increased leisure in which to consume its increased product.

These processes continuously take place in a progressive economic society to reconcile the experience of the “practical man” and the reasoning of the “theoretical” economist. In the short period machinery does replace labour and cause unemployment. That is what the practical man knows and understands. But the economist is equally right to point to these slower, less spectacular, yet inevitable processes of readjustment, slow expansion and new recruitment that are going on every day in a growing system. And it is these slow processes which count in the long run. More people are in full employment now (1934) than ever before in the history of the country! There was an enormous and spectacular increase in the volume of machinery used in this country from 1780 onwards. Such an increase of machines as would—if the practical man were right—have replaced the greater part of the working population of the country. Instead, no less than four times as many people were given industrial employment at approximately four times the standard of living by 1913. Machinery had caused the demand for labour to rise by 1600

per cent ! There has been a less rapid but nevertheless, a considerable increase in machine installation between 1913 and the present day. Instead of falling, the volume of employment has risen by 10 per cent and the average of real wages by something like 30 per cent. Those are the inescapable hard facts to which the "theoretical" economist can point.

There is no doubt that, in the long run, machines are the indispensable friend of the worker and the working-class.

Secondly, the analysis of this section throws light on the proposal to use the increased productivity due to the machine wholly to reduce the hours of labour and maintain wages. The policy involves holding real wages constant and if the increased productivity due to the installation of the machine is 10 per cent, to reduce hours by 10 per cent. Since the increase in efficiency is everywhere absorbed by the reduction of hours the total product of industry will not be at all improved. Two results follow from such an arrangement.

1. Producers' labour costs are kept up when they would have fallen. They are required to employ the same number of men at the same wage for shorter hours. The producer's total wage bill remains the same and his output will remain the same and his profits will remain the same. The increased efficiency will leave everything as it was except that the hours of labour will be reduced. So far so good. But it is essential to realize that the producer's costs *have*

not fallen as they would have fallen had the reduction of hours not taken place. If the workers had worked the same hours for the same wage the increase in output would have been accompanied by a fall in costs per unit. That fall has been prevented by the reduction in hours. It does not matter in the least that costs should be stabilized in this way *in a self-contained community*. All producers will be in the same position. Hours will be falling everywhere and no group and no trade will be particularly hard hit. But the position is not the same in the export industries of a country engaged to an important extent in foreign trade. In their case *unless the reduction in hours is agreed to upon an international scale* the reduction in the hours of labour will at home lead to home costs rising above foreign costs by the extent which they have not fallen. The foreign competitor will be in a position to undersell the home exporter. Foreign trade will be reduced. Imports will be cut down and a serious economic position may develop. It is therefore only upon an international basis that the proposal can work quite smoothly, and it is a good thing that the agitation for a 40-hour week is an agitation upon an international scale.

2. Nevertheless it would not be impossible for any country to contemplate a certain reduction in its foreign trade, and within the limits set by its maximum import requirements the reduction of hours to this extent becomes possible. In so far, however, as the policy is carried out the standard of living in all commodities other than leisure is

prevented from rising as rapidly as it could. It is, of course, a perfectly sensible course for the workers to take the view that they prefer an increase in leisure to anything else in the world, but it is essential for everyone to understand that the extra leisure implies a certain sacrifice and is not the only reasonable use to which greater productive efficiency can be put. In the long run and after a series of painful adjustments, it is perfectly possible to use the whole of the increased efficiency of the machine to raise the general standard of living.

That, in a nutshell, is the lesson of the whole of this analysis. The machine is not the enemy of the worker in the long period of history. It may displace individuals and injure beyond hope of repair the interests of whole groups. But in the long run and for the whole of society the machine is the friend of man. It calls upon him to grow in wisdom and to adapt himself to change, but it strengthens his hand as nothing else can in the struggle to win subsistence and wealth from the natural world about him.

V

THE CONTROL OF THE MACHINE

And now the cynical reader will be thinking : " Just what we would expect from an ' orthodox ' economist—all this palaver to justify the world precisely as it is—no policy, no change." The optimistic conclusion of the last section must not be taken to indicate that the economist is con-

cerned in the very least to defend the present economic code or to pretend that "everything is for the best in the best of all possible worlds". On the contrary, I wish to revert at once to the promise given in the first section of this essay that I would do my best to discuss what is really wrong and what ought to be done about it. It would be foolish to deny that something is wrong. To argue that nothing can be done about it would be dangerously pessimistic. What we must know is what is really wrong and what remedies will actually cure the existing evils. What are those evils?

In the *first* place it is obvious that a great volume of unemployment does in fact exist. If we study the history of the matter it appears that unemployment has not either suddenly appeared in modern economic society nor has it grown steadily greater up to its present volume. Unemployment has gone in waves. It has grown worse and then grown better. In the best of times—during the "boom" periods of past trade cycles—it has fallen to next to nothing, while in depressions it has risen as high as 20 per cent. The average period of these movements has been between five and seven years.¹ These great movements of industrial prosperity are unquestionably the real cause of the greater part of the unemployment from which we suffer. It is, however, inconceivable that they are due to the installation of

¹ See Pigou, *Industrial Fluctuations*; Frontispiece and relevant text. Wesley Mitchell, *Business Cycles*, chapter II *passim*.

machinery. We have already seen that there is every reason to believe that machinery increases the demand for labour, and in any case the installation of machinery progresses steadily from cycle to cycle. If it were responsible for unemployment then unemployment would grow greater from cycle to cycle—which it does not.

If then machinery cannot be regarded as the main cause of these movements what can be so regarded? This is not the place to embark upon a long discussion of the theory of the Trade Cycle.¹ It is enough to point out that there is very general agreement among economists that the real explanation of the main impulse behind these big movements is to be found in the sphere of money and that the main hope of cure lies in the pursuit of a different credit policy from that which has been pursued in the past. Although economists still differ very greatly over the precise nature of the change that is required, yet they are all agreed that *some* change is necessary and this is the first positive proposal that can be made in the sphere of policy. Now if the Trade Cycle were cured by a correct credit policy, then the identification of machinery with the large movements of unemployment would become impossible and the bottom would drop out of the popular case against machines. Nevertheless it would still be true that the installation of new capital is bound to cause certain local and temporary displacements of labour. In this sense it is *a* cause, although not

¹ See such books as Roll's, *About Money*, Pt. II, or my own *Purchasing Power and Trade Depression*, passim.

the cause, of unemployment. It is responsible for *technological unemployment*, and the economist must consider the problem that this type of unemployment raises.

Secondly, therefore, the economist must concede that machines under dynamic conditions are capable of occasioning a great deal of human misery. The installation of new capital that replaces labour will mean that certain human beings are thrown into enforced idleness for the remainder of their lives. Elderly miners are not likely to be offered jobs in new and expanding industries, and even if they were, their natural attachment to certain places and ways of life would make it exceedingly difficult and probably impossible for them to move. Machines mean for them perpetual unemployment, and the same is true for all workers over a certain age who are replaced by machines.

Our existing arrangements—or lack of them—aggravate this problem to a shocking degree. The absence of a constant survey of industry and labour mobility means that when a certain number of workers have to be displaced in a particular industry, just the very workers who should not be displaced—the elderly and less adaptable members of the labour force—will be dismissed. It is socially desirable that the younger, less specialized and more easily trained workers should be removed from one industry just because they can be trained with least difficulty and cost to take the new posts that must be appearing somewhere else in the economy. It is just these persons who tend to be kept in employ-

ment while the labour market becomes crowded with specialized workers whom it is impossible to train for other work.

These facts constitute an overwhelming case for the development of a much closer survey and control of the movements of labour made necessary by technical change. It should be perfectly possible to see that if labour displacement is required that only young and trainable men and women should first be discharged and that in every case some alternative work should be found. In order that the alternative work should appear it is, however, necessary that wages should not be kept up in expanding and prosperous industries. These wages—the high wages—must not be rigid downwards or else the rough equality between the real wages in various employments—an equality necessary to the complete absorption of labour—will not be realized. Moreover it is necessary and justifiable that the costs of operating this superior Employment Exchange machinery and of training the displaced workers for their new employments should be charged in the industries which are displacing them. These costs are part of the real loss to society that should, on the strictest economic calculation, be set against the other benefits accruing from the use of the new machines. It is consequently right that part or all of them should be charged to the industries that will immediately benefit by the change. Otherwise an entirely false premium will be, is being, set upon technical restlessness.

Such arrangements as these will reduce to a

minimum the unemployment and direct financial loss that the worker is called upon to pay as the price of general economic advancement. But it will not destroy it entirely. Although a very large number of the young and adaptable workers forced out of employment will secure new jobs the general lack of security and the psychological strains of the change will remain. It is therefore open to the economist to suggest a quite different and more radical solution. It would be quite possible to secure a moderate but considerable rate of technical change *without requiring a single man to alter his employment—without a single example of technological unemployment*. At first sight this may seem too good to be true. Yet it nevertheless is true. There is a normal rate of loss balanced by an equal rate of recruitment in every static industry. In the coal-mining industry the rate of loss from death, old age or spontaneous withdrawal is as high as 5 per cent to 10 per cent per year. In industry at large it will be—apart from changes in the size of the population—equal to $\frac{1}{n}$ th of the working population

where n is equal to the working life of the average worker, measured in years. If the average working life is twenty years, then one-twentieth or 5 per cent of the workers in any static industry will be withdrawn from it every year. If it were laid down that labour-displacing machinery should only be introduced at a rate which reduced the demand for labour in that industry by as much as it would normally diminish, then the whole of

the necessary process of change could be carried through without causing a single individual to lose his or her job. The labour force of the industry would be reduced to the requisite extent but entirely by natural withdrawal and not at all by enforced idleness.

It is probable, though not certain, that in a world freed from the oscillations of the Trade Cycle this general rate of advance would be less than that which would occur without such restriction. In that case the pace of technical change and increasing productive efficiency would be forced down, and in so far as we were in competition with countries not similarly controlled our export industries would be injured. That would constitute the inevitable price which must be paid by society to avoid the miseries of technological unemployment, and it must be remembered that the loss of competitive advantage would be far less than the complete cessation of technical improvement against which I have already pleaded.

We may therefore conclude that there are at least two ways in which the present unsatisfactory position could be improved. Machinery can be created which will facilitate the mobility of labour and taxes for its maintenance can be imposed which will correct the present bias in favour of machine production. And it is possible to go further than this and at the price of some reduction in the rate of technical advance to cure technological unemployment for ever.

There is, however, a more serious hurdle in front of us.

Thirdly, the economist familiar with recent discoveries in the field of monetary theory will have recognized a problem which these discoveries are forcing into the open. The economist can easily show, as I have shown, that the installations of new machines will always benefit the economy as a whole. He can also show that, in the long run, they will benefit labour by enormously increasing the output of goods consumed by the worker. But it is not always certain that the machines will benefit labour *relatively* to the other great factor of production in modern life—property or capital. The installation of machines, while benefiting labour absolutely, may benefit the employer or the property owner even more than it does the worker. If this is the general tendency throughout the system, then the *proportional share* of labour will fall. Labour will obtain a share of a larger cake, but it will be a smaller share. It is most unlikely that the share will be so much smaller relatively to the increase in the size of the total that the absolute size of the piece of cake will be less. That possibility is not altogether ruled out, but it is so unlikely to be true in the long run that we can afford to neglect it. Unfortunately the mere fall in labour's share creates serious difficulties of its own.

It would not in the least matter if it were generally held that the cost of living or the prices of final output could be stabilized. If that were the case every increase in the absolute share of labour would be accompanied by a rise in the total money earnings of the workers, and with a

constant working population by a rise in the level of money wages. But it is increasingly dubious whether it is possible to stabilize prices, and a certain consensus of opinion suggests that in a capitalist and unplanned economy it would be better to stabilize total incomes with a stable population. If this is the case, the change in relative shares becomes important. Should the installation of machines reduce the relative share of labour, then it will be reducing the share of a constant money total. Real wages will rise because the cost of living will fall more rapidly than money wages, but the installation of capital will have the tendency to force down money wages. No one can deny that this would provoke a serious reaction.

Nor has the economist as yet any easy solution to offer. On the one hand it may be difficult or impossible within the existing framework of banking institutions to stabilize prices. On the other hand it would be disastrous—suicidally so—to stop technical advance. Faced with this dilemma society in general and the organized workers in particular must choose between a restoration of greater freedom in the movement of money wages or set up the adequate machinery for the control of banking and the stabilization of prices. As both these alternatives raise problems of a general economic and social significance it is not possible to pursue the discussion of them here. It is enough to say that there is no real economic dilemma. Either prices can be stabilized in a sufficiently planned economy or money wages

can be allowed to move more freely. Either course will remove the particular difficulty arising from changes in relative shares and thus release machines to the full exercise of their beneficial economic function.

Finally, it may be asked what the economist has to say about the second argument against machines mentioned at the very beginning of this article. What of the tendency of machinery to change the life of the worker, to destroy skill and impose upon him physical and nervous strains that make life intolerable? It is probably not quite true to say that modern machines destroy skill. What they tend to do rather is to divide the working population into two sharply differentiated classes—one a highly skilled and highly trained machine engineer and the other a very low-skilled and untrained machine-tender. But what of the more general charge—that machines make life hard and nerve-wracking for the individual worker? That is not for the economist—nor for any one man of any kind—to say. What is really involved is a choice between two ways of life. It is not possible to have a high standard of life without high-powered and highly mechanized production. It is possible to have either a simple and quieter form of factory labour at the existing level of mechanization and skill together with the existing quantities of consumption and leisure or it is possible to press up the degree of mechanization and consume more and work less. It is not possible to do both.

And that is a choice that the common man must

make—a choice that no specialist, no Dictator, and no Government can rightly decide. It is the business of the common man to say which he wants. He is called upon to be the judge of his own happiness, and we have not, at least in this country, wholly abandoned the hope that by the slow process of public opinion and democratic action he, the common man, will be able to create the world in which he wishes to live.

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VI

CONCLUSION

So in my view, the real truth about the Machine is this—it can be used almost indefinitely for the benefit of human life and happiness if it is properly understood and properly controlled. It is not true to say that machines are the enemy of man. Neither is it the whole truth to say that they are always his friend. Just as the discoveries of chemistry and physics can be used either to raise the output of agriculture and banish starvation from our midst or alternatively to manufacture high explosives, liquid fire and poisonous gas to destroy women and children from the air, so can machines be used either to raise the general standard of living or to destroy all sense of security and well-being in life. I cannot believe that the right way for us to go is to abandon all that we have—economically speaking—fought to build up and achieve in our already highly mechanized order. I cannot believe that we should be wise to go back upon the past and to attempt to

build up from the beginning a new and more primitive culture. It is not impossible to do that, but it is not easy and it is not necessary. Instead we can learn from the past. We can accept all the abundant wealth, the hope of plenty, and the promise of leisure which increasing mechanization has always offered. But we can refuse, as a society, to be overwhelmed by the floods of change, to be unseated from the place of authority in the management of our economic affairs. We can say to the sea that it must roll back or that it must fill in due order and season the channels that we have chosen. We can assert our right to control and foresee the processes of alteration that we permit, and having permitted, welcome. We can refuse to be launched unseeing upon a chaos that is unknown. We can guide and preserve our economic destiny.

BOREDOM AND WORK

By WINIFRED RAPHAËL

It is perhaps significant of the present epoch that boredom is considered the most unpleasant of all emotional states. Positive loathing, anger, even fear or pain have some interest, but the utter negation of boredom makes people say—though they may not entirely believe it—that boredom is a worse condition.

Is this growing fear and hatred of boredom directly due to the greater mechanization of work? Does the number of yawns per head of the population bear a relation to the number of machines running?

What is this much-feared boredom? It is the absence of interest, a condition in which natural desires have no chance for expression. If a man is building a wireless set for himself in a shed in the backyard he is satisfying some of his instinctive tendencies, and goes on attending happily until his interest is satisfied. But if the same man must, day after day, assemble a small portion of a wireless valve in the factory he will often have to force his mind to attend to it when he wants to think of other matters.

What each person finds interesting and what he finds boring is entirely a personal matter. Most

people experience at an early age the terrible ennui of sharing a companion's pleasure. The industrial psychologist soon realizes the impossibility of foretelling what occupations will be considered dull. Go into the department of a factory where the work seems absolutely soul-killing—say, inserting little corks into tooth-paste tube caps, several dozen to the minute, and to your surprise you will meet real enthusiasts. They will say, "You can't think how interesting this job is." ("Interesting" is the word deliberately chosen!) "The corks come up different each time!"

There is a pride in skill unrealized by the ignorant onlooker. "He's orl rite for good strite sweepin'," said the foreman street-cleaner of one of his underlings, "but when it comes to a ticklish bit o' work like cleanin' round the lamp-posts, you carn't trust 'im."

Theoretical reformers sometimes glibly suggest that periodical changes from job to job would reduce the boredom of working at machines. Should these well-meaning philanthropists try to introduce such a scheme, they would find themselves meeting strong opposition even when it in no way affects wages. I remember once finding a girl in tears while she worked at her press which was shaping tin cans. She had just returned from her holiday, and, she confided between her sobs, that while she was away someone else had used her machine. It had not been spoilt in any way, she said, "But I love that machine like a baby, you know, and if I had known that any-

one was going to work it while I was away, I would have given up every day of my holiday ! ” Any foreman would corroborate such cases of real affection for a seemingly unpleasant job and the difficulty of persuading workers to change their work.

Although boredom differs with the individual, it is probably safe to say that work which is entirely mechanical is not the most boring. The worker can then safely indulge in day-dreams or conversation, and distract his mind from the dull task that his hands are performing. The worst jobs are those which are repetitive but demand constant attention, examining for instance, or packing. This kind of work is especially trying when the articles are marked so that any sub-standard article passed in error will be traced to the worker. Woe betide the day-dreamer in such a position and yet the monotony of the work is entirely unrelieved !

Boredom is no respecter of persons. While the idle rich may discover a terrible tedium in their long hours of leisure, the industrious poor may make the same discovery in their long hours of work. But the problem we are trying to solve is whether machine workers on the whole suffer more from boredom than other workers. To make such a comparison fairly, we must pair occupations needing an equal amount of skill. We ought not to compare a master craftsman with a routine press worker, nor a window cleaner with a ship's engineer. All we can do is to compare the routine machine job with the unskilled

manual job, and the able mechanic with the clever craftsman, and then make presumptuous guesses.

Those who declare that machine workers have the more interesting time, speak of the immense fascination for machines felt by most men and many women. A babe of three will often desert all other toys to watch the wheels of an engine go round and this interest persists throughout childhood. Every vocational adviser knows that "An engineer please, sir," is the most frequent answer given when boys are asked what they want to be. This fascination to man of the machine may be due to the enlargement of his ego, the adoption of the capabilities of the machine—its power, speed, or skill, as his own qualities, but whatever its cause it is immensely strong. Fortunately most machines are almost human in their capacity for going wrong and needing attention, so that the skill of the mechanic is not generally allowed to lie idle.

The mechanic may be fascinated by his job, but probably the creative hand worker obtains an even deeper satisfaction in contemplating some object that he himself has made. "I made that lovely thing" is indeed a justifiable cause for pride.

But comparatively few manual workers have the joy of directly creative work or even the happiness of completing a whole piece of work whether a chair, some pottery or a boot. Skilled engineers and creative craftsmen are the fortunate exceptions, the lucky few who can take interest directly in their work. There is probably little to choose in the opportunities for boredom between a typist

tapping monotonously on the keys and a copying clerk painfully pushing his pen ; between a hand or a machine dishwasher ; or even between a machine embroideress working at an enormous speed over the petals of fat, pink satin roses, and the hand embroideress painfully following the outlines of daisies on each of a gross of handkerchiefs.

The sad truth is that most people must find their interest in the surroundings of their work rather than in the work itself. The environment is often the reason for choosing a job. The solitary man will want to work in the fields or alone in a small office. But most people—especially those of average or below average intelligence—are strongly sociable. Man is to a large extent a herd animal and the factory worker gains by being part of a community. There is interest and excitement in gossiping over the foreman's latest doings, or the current rumour about a change in piece rates. Modern conditions in factories, the shorter hours, the rest pauses, canteens and athletic clubs give many opportunities for enjoying social contacts. Trade Unions and Works Committees give opportunities for leadership and organizing ability ; and even those who have no official positions find such local politics a valuable centre of interest. It is perhaps significant of the desire for companionship that a high proportion of girls want to return to work after marriage even though there is no need to supplement the family income, because they find " It is so lonely at home ! "

Some firms make a practice of filling most of their higher positions by promoting the rank and file. This creates a goal towards which the efforts of an ambitious worker can be directed, and such an incentive greatly relieves the tedium of dull work. Other firms adopt the policy of recruiting all their executive staff from University or Public School men. It is, however, a great mistake not to leave any places for promoted workers; the stultifying effect on the staff of a lack of opportunities for promotion soon becomes apparent. The industrial worker is already at a disadvantage compared to the professional, in that if he remains in the same job and is paid piece rates he will very likely receive his highest wages when he is in his twenties or thirties. As he gets middle-aged and more easily fatigued his output will fall and his pay will actually diminish unless he receives some form of promotion.

Probably the physical exertion is small for the majority of machine workers compared with such manual work as mining, farming, building or road-making. Physical conditions have improved lately in modern factories; they are properly heated and ventilated, well lit, and have sensible seating accommodation. But the mental strain for many machine workers is far greater than any physical strain. The more expensive and complicated the machine, the greater the strain; one small mistake and hundreds of pounds' worth of machinery is thrown out of commission, and very possibly the production of that department seriously delayed. The importance of

holding a job in these days of frequent unemployment means constant anxiety and uncertainty. Once a man aged more than forty, or a woman aged more than thirty is "out", they know of the terrible difficulty of getting another position.

There is a further increasing anxiety resulting from the new bonus systems in which a worker's output is accurately known. The effect of those systems combined with a bad management is to make a worker feel that he is being "speeded up" and will be dismissed if he cannot keep up to standard.

Curiously enough the word "boredom" is not as yet part of the English working-man's vocabulary; "fed up" is commonly used, but it expresses a more active emotion than boredom. Probably boredom is complained of more openly by shop assistants and some office workers. They often suffer, and suffer badly, from having too little to do. Their work comes in rushes with long idle pauses between. Sometimes they are not allowed even to sit or talk, and certainly not to read. They must look alert, bright and efficient, prepared for the work that may come at any moment. Although hours for such workers are often shorter than factory hours, they have far more time to realize their boredom.

Whatever the work, boredom is likely to result if the worker is not suited to his job, particularly if he is too intelligent for it. Some years ago Professor Burt and I tried to obtain some rough approximation of the distribution of intelligence among the general population and the level of

intelligence needed for their various occupations. Our findings are summarized in the following table (taken from the Industrial Fatigue Research Board, Report No. 33).

DISTRIBUTION OF INTELLIGENCE AVAILABLE AND REQUIRED IN VOCATIONS

(1) Level of Intelligence (in mental ratio).	(2) Educational Category or School.	(3) Number of Children (in percentages).	(4) Vocational Category.	(5) Number of Male Adults (in percentages).
1. Over 150	Scholarships (University Honours)	0.2	Highest professional and administrative work	0.1
2. 130-150	Scholarships (secondary)	2	Lower professional and technical work	3
3. 115-130	Central or higher elementary	10	Clerical and highly skilled work	12
4. 100-115	Ordinary elementary	38	Skilled work. Minor commercial positions	26
5. 85-100 .	Ordinary elementary	38	Semi-skilled work. Poorest commercial positions	33
6. 70-85 .	Dull and backward classes	10	Unskilled labour and coarse manual work	19
7. 50-70 .	Special schools for the mentally defective	1.5	Casual labour	7
8. Under 50	Occupational centres for the ineducable	0.2	Institutional cases (imbeciles and idiots)	0.2

The first column shows the level of intelligence or mental ratio. This figure is obtained for children by dividing the age which a child is equal to mentally by his chronological age and

expressing the result as a percentage. Among adults the range of intelligence varies as widely as among children, and it is convenient to use the same method of expression. The last column of the same table has been computed from the London Census returns and shows the approximate percentage of persons following trades or professions in each class. This full list comprises all the main occupations, but the following examples will show how some workers connected with machines are classified :

- Group 1. Professional Engineer, Managing Director.
- „ 2. Factory Superintendent, Technical Engineer.
- „ 3. Electrician, Compositor, Lithographer, Photographer, Tool-maker, Pattern-maker, Machine Inspector, Foreman
- „ 4. Engine-driver, Bus-driver, Mechanic, Turner, Fitter, Miller, Routine Typist.
- „ 5. Fairly mechanical repetition work requiring low degree of skill, Driller, Polisher, Textile-worker.
- „ 6. Unskilled labour, Automatic repetition work, Labeller.
- „ 7. Simplest routine work.
- „ 8. Unemployable.

It is most interesting to compare columns 3 and 5, the intelligence available and the intelligence needed. The two show a marked similarity though there are too many positions for the

stupid person (group 6) and too few for the ordinarily intelligent (group 4). Apart from this, it would be theoretically possible, in a better-organized community, not to waste the intelligent on routine jobs, and not to have difficult jobs badly done by the willing incompetents. It is one of the first duties of the educational and industrial systems of the country to find the mental level of each individual child and help him through training and other methods to enter the career for which his abilities are suited.

At one firm recently, two men were discharged, within the same week, one for incompetence, and the other for habitual drunkenness. An interested psychologist examined both men. The incompetent man was found to be keen but stupid and had been given a job too difficult for him. The drunkard was brilliant but had been placed in a routine job, and could only find one unfortunate way of relieving his tedious work. Two tragedies typical of many!

But intelligence is far from being the only factor in vocational suitability. Two people can be of the same level of intelligence and yet one be a success and the other a failure at the same job. One must consider their mechanical ability, for instance, whether they have a "machine sense" or not, their manual dexterity or skill, and often their memory and observation, and many other abilities. Most of these qualities can be fairly accurately assessed by means of tests, and the modern firm often applies such tests to all applicants for positions, to see if they have suffi-

cient potentialities to become skilful workers, and to discover at what processes they would be most likely to be successful.

Temperamental factors must also be considered, such as interests, tastes, fondness for being with people, animals, or machines. It is no easy task to measure a person's mind and fit him with the job that suits him best—but when it is satisfactorily done the chances of his being bored with his work are greatly reduced.

What can we expect of the future? Machines are becoming capable of increasingly complex operations and can obviously do them quicker and better than we can. Photo-electric eyes are more accurate than human eyes. Is it unreasonable to hope that it will become almost obsolete to employ people for routine mechanical work? More and more engineers will be required to keep the machines in order, but slaves will not be required to feed the machines and to examine its products.

But as machines increase in complexity, and the production per head of the population is obviously greater, it is generally assumed that there will be considerably shorter working hours and the problem of boredom may then shift to leisure hours. Films and football matches which many find adequate now to fill the few hours of leisure they enjoy, will not be sufficient when there is a four-hour working day and a five-day week. Since the war there has been a striking development in the demand from workers for further opportunities for education and for exercise, but the gift of leisure while workers are feeling sufficiently fresh

to enjoy it, is still the exception rather than the rule. We can hope that those very machines which make the working hours tedious, will be the means of releasing people, still feeling vigorous, at the end of a short day and free to enjoy whatever interests them most deeply.

